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ORGANISATION OF SCIENTIFIC RESEARCH

IT has become increasingly clear in recent years that applied research and development are indispensable for the maintenance of reasonable standards of life in any nation—by developing new technologies in the service of humanity and in the service of the nation through new products, improved processes, higher outputs and improved health and welfare. The need to organise applied research and development work has always been obvious to industrial units, but the concept of a *national* organisation is new and in many countries is only now being attempted.

There is no standard formula for the organisation of research. Differences in political and economic maturity in the stability and structure of industry demand that each country should devise its own form of national organisation. However, certain elements common to all countries are discernible, and these relate to the formulation of a national research policy, the nature and structure of research establishments, realisation of a wholesome research climate and finally, means and methods of administration and finance. It is therefore clear that the experience of other countries in such matters has a great deal to tell us how we can solve our own. In this connection the Report* of the Technical Assistance Missions set up by the Organisation for European Economic Co-operation (OEEC) to study the organisation of applied research in Western Europe and North America, contains a wealth of useful data and suggestions, which merits careful study. The following is a summary of some points of general interest in this report.

* *The Organisation of Applied Research in Europe, the United States and Canada:* Vol. I—A Comparitive Study, Vol. II—Applied Research in Europe, Vol. III—Applied Research in the United States and Canada. Published by the Organisation for European Economic Co-operation, Paris 16e, 1954, Price: 1.00, 2.00, 1.25 dollars respectively.

In all the countries visited by the Missions it has been observed that large and middle-sized industries themselves provide the applied research for their healthy growth, while the Government shoulders the responsibility not only of the research effort for defence, atomic energy and public health, but in great part finances also the institutions for the education of the research personnel, fundamental research, applied research in agriculture as also that of small industrial firms. The importance of private endowments for research would seem to be diminishing, while industry and Government remain as the two great powers behind research.

In view of the complexity of research activities, every country visited has found it necessary to create bodies to supervise and co-ordinate such activities. However, in only a few instances have these bodies given serious thought to the formulation of a national research policy in their fields of interest, taking into account the supply of scientific talent, the natural resources of the country and the needs of industry. It has therefore been suggested that from time to time the national research effort should be evaluated and guidance laid for future research. The result should not be a hard and fast set of executive orders, but rather a memorandum providing information and reasoned recommendations so that it might act as a stimulant to both administrators and research men.

It is a common saying that while Europe has excelled in fundamental research, the Americans have mastered the art of transforming scientific results into practical applications. By way of comment, the report observes that in general the research worker in the United States has undeniably a greater urge to produce practical results, while in Europe there are still some remnants of the old academic schools which pursue scientific research for the sake of pure science, and look down on scientists who do research for industry. However, a large volume of applied research *has* been carried on in Europe for some time now, just as there have been unsurpassed achievements in fundamental science in America. It may well be that any difference in the emphasis placed on fundamental and applied research in various countries reflects a difference in temperament and philosophy, but the balance between the two is a delicate one for any country, and should be maintained at the point as which it yields the greatest return, whether it be to the Government or industry.

The spectrum of national research effort recommended by the Missions as likely to be most helpful is as follows :

(*a*) Universities should concentrate primarily on teaching and fundamental research; but Institutes of Technology should include semi-technical and pilot scale work.

(*b*) Industry should (and in the larger concerns normally does) cover the whole field of applied research and development.

(*c*) Government research establishments, depending on the industrial responsibilities of Government Departments, should pursue their applied research to the point at which results can be applied or used for further development in industry, or to the point where reliable advice can be given to guide administrative action by Government Departments. It is assumed here that Government research establishments, where they exist, fulfil a national need in applied research which is not being met elsewhere.

(*d*) Co-operative research establishments, as they exist to serve branches of industry, should cover the whole range of industrial application in their particular field of interest.

(*e*) The field for sponsored research institutes is to be determined, after duly considering the capacity and efficiency with which industry and Government find it possible to cover their own requirements.

The report has much to say on the conditions which contribute to the creation of a proper research climate. A good research organisation must combine proper management and effective research programmes with an adequate reserve of "scientific capital". This capital is usually composed of individual creative scientists with no administrative abilities, whose talent must be properly harnessed. Considerable care should be taken in recruiting staff to ensure that they are suited to the requirements of the research programme and remuneration should be related to scientific value rather than administrative or practical ability. There should be reasonable parity in the salaries of professional, technical teaching and research staff. Last, but not the least, it is necessary to create public interest in scientific research. Such an interest, especially in applied research, would appear to be fairly widespread in most

countries, but there were many instances where such interest had not penetrated deeply enough into Government and the industrial circles to initiate active national programmes or convey the real importance of research. This state of affairs should be given serious consideration by appropriate bodies and especially by the scientists themselves. The report observes that people in authority cannot always be blamed for lack of understanding, as they are not specialists and cannot be expected spontaneously to realise all the possibilities of science and technology. In this connection, while it is reasonable for scientists to use a language of their own when discussing problems between themselves, it is at least equally important that they should contrive to make themselves understood by the layman as regards their plans, working methods and results. The popularisation of science should be an integral part of the organisation of research. A great deal about how to conduct such a campaign for the better understanding of research can be learnt from institutions such as the American Chemical Society.

Many of the suggestions put forward by the Missions are directly applicable to our country in its present state of rapid scientific and industrial progress. It is to be hoped that the matter will be taken up for full consideration by those who share the responsibility of shaping the industrial future of our nation.

NOBEL PRIZE FOR PHYSICS, 1954

THE prize this year is shared by Professor Max Born and Professor Walther Bothe. Professor Max Born is well known for his researches in various branches of theoretical physics. He was among the pioneers who developed the new quantum mechanics in the 1920's, the basic ideas of which have had a profound influence on the progress of physics ever since. More recently, he has made significant contributions towards the unification of the theories of matter and field, and of relativity and quantum theory. During the last few years he has contributed a number of articles on the philosophical foundations of quantum mechanics. Prof. Born has been deeply interested in crystal physics, and is the author of a number of books on this subject. In addition, he has published a large number of books on atomic physics, quantum mechanics and theory of liquids and also semi-popular accounts of modern physics and its philosophy.

Professor Born was in India for short period in 1936, after which he accepted the Tait Chair of Natural Philosophy in the University of Edinburgh. He retired from this position only last year.* He is now seventy-one.

Professor Bothe, who is sixty-three, is a specialist in the field of X-rays and electron physics. His early work was mainly concerned wtih the scattering of X-rays and the photo-electrons ejected from matter by X-rays. Together with Geiger, he performed the celebrated experiment on recoil electrons in the Compton effect, and proved definitely that one quantum of X-ray interacts with a single electron in this effect. This paved the way for the further development of the quantum theory of radiation.

Prof. Bothe was associated with W. Kolhorster in a discovery made in 1929, which led to a new and valuable method for the study of cosmic rays. They found that a ray which passed through two Geiger counters in succession was likely to discharge both of them. By suitable arrangements of counters it was possible to define more or less accurately the path followed by individual cosmic rays. A year later, with H. Becker, Bothe was responsible for the first experimental observations in a sequence of discoveries which culminated in the recognition by Sir James Chadwick in 1932 of the neutron as a fundamental particle.

During the years 1939 to 1945, Professor Bothe was engaged in the official atomic research programme in Germany, after which he returned to academic life as Professor of Physics in the Heidelberg University. He has continued his interest in electron physics, although of late he has been specially interested in its applications to cosmic rays and nuclear physics. Amongst other publications, Professor Bothe has to his credit two articles in the *Handbuch der Physik* dealing with the Transmission of Electrons through Matter and the Absorption and Scattering of X-rays.

* A review of the "Festschrift" presented to him on this occasion appears elsewhere in this issue.

NOBEL PRIZE FOR CHEMISTRY, 1954

THE award of the Nobel Prize for Chemistry to Professor Linus (Carl) Pauling marks the recognition by the scientific world of the outstanding advances made by him in recent years in the field of protein structure.

Our knowledge of the molecular architecture of the protein molecule is now being developed from two directions. One relied on making a direct attack on the intact protein complex in the beginning, and the results seemed to be rather discouraging. Pauling in 1937 decided to attack the problem from another direction by accurately determining the detailed structure of smaller units of the protein molecule such as the amino acids and peptides, thus permitting a good insight as to how the peptide chain would naturally fold itself to form a protein molecule or fibre. After several of these structures had been determined accurately enough, he showed the formation of helical or pleated sheet or layer configurations as structural elements in the several proteins. He also showed that the helices may be twisted about one another to form a compound helix or coiled coil giving rise to configurations like three- or seven-strand cables.

Pauling's investigations cover a very broad field of science including parts of physics, mineralogy, chemistry and biology; but, though varied in nature, they have had a common feature—an emphasis on structure and they may all be considered as being comprised in the general subject of modern structural chemistry. In addition to picturing for us molecules ranging from the simplest to the most complicated proteins and silicates through the determination of many molecular structures, interatomic distances, bond angles, covalent radii and electronegativity of atoms, and binding and resonance energies, he will be remembered for his pioneering work in applying the methods of quantum mechanics to chemistry, and also for popularizing the interpretations of quantum mechanical reasoning and the resonance principle to chemists.

Born in Portland, Ore (U.S.A.), Pauling received his B.S. from Oregon State College in 1922 and his Ph.D. from California Institute of Technology in 1925. Since 1937, he has been Chairman of the Division of Chemistry and Chemical Engineering and Director of the Gates and Crellin Laboratory at CalTech.

A. B. BISWAS.

RADIOISOTOPES IN INDUSTRY

A BRIEF news report in *Chemical and Engineering News* (1954, **32**, 3036) mentions a few of the monitoring tests that radioisotopes are carrying out. Antimony-124 is being used to check oil pipe line flow; heavy losses are saved every time a change from one grade to another is made. With a Geiger counter at a suitable point outside the pipeline, the arrival of the new grade, if it contains the radioisotope, can be accurately judged. Manganese-54 is being used in paint mixing: minute amounts of this isotope added to the pigment enable the point of uniform mixing to be correctly assessed. Geiger counters on two stirring paddles show uniformity of mixing when each of them records the same amount of radioactivity. Leak detection in enclosed water systems is being aided by iodine-131; the point of leakage can be readily located by the large increase in gamma radiation there. The emission of radiation from radioisotope capsules can be used to measure the thickness of surface coatings while they are being applied to metals. Similarly, flaws in metal castings or welding are shown up if a capsule is placed on one side of the material and a film on the other. Radioisotopes can also be used to eliminate static electricity. Indeed, the known uses are already very numerous although the full potentialities of radioisotopes as control agents in industry have not yet been approached. The AEC has delivered approximately 50,000 consignments of radioisotopes to users in the United States since commercial distribution began.

ELEMENTS OF THE HELICAL STRUCTURE OF COLLAGEN

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IN a recent communication from this laboratory,[1] a structure has been proposed for collagen consisting of cylindrical "ropes", each rope containing three separate helical chains which are connected together by hydrogen bonds. On the basis of the structure, the meridional arc of spacing 2·86 Å was interpreted as the 113 reflection. The studies of Cowan *et al.*[2] with stretched collagen indicate that this reflection is truly meridional. Recently the present authors have made similar studies under various conditions, such as different degrees of stretching and moisture content, and these confirm that the 2·86 Å arc is a true meridional reflection. The arc occurs in a photograph taken with the fibre axis at right angles to the X-ray beam only because a small fraction of the fibrils is highly disoriented. When the orientation is improved by stretching, both the intensity as well as the spread of the 2·86 arc diminish for the normal setting, while if the fibre is oriented at the correct angle for the meridional reflection, the 2·86 spot appears with greatly increased intensity. The 4·0 arc on the other hand, breaks up into two well-defined non-meridional reflections when the fibre is tilted to the appropriate angle.

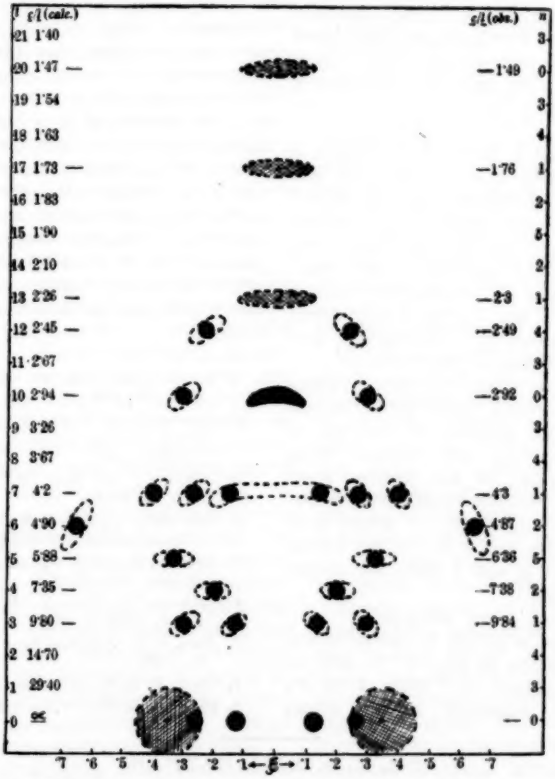

FIG. 1. Schematic diagram of X-ray diffraction pattern of stretched collagen.

In view of the above, the earlier structure clearly requires revision. The photographs obtained show unmistakable evidence of the structure being helical, and they have been analysed with a view to determine the elements of the helix. Cohen and Bear[3] have proposed a helix making 2 turns in about 20 Å and having 7 groups of three residues each in two turns. Bear (private communication) has

made some changes in this description, but the details are not known to the present authors. A careful analysis of the photographs of well oriented collagen show that the experimental data are not fully explained in terms of the above helix having $c = 20$ Å, but that they fit in well with a c-axis spacing of 28·6 Å. The data observed are schematically indicated in Fig. 1, where the layers are arranged according to their l-value and the ξ values of the reflections found in each layer are indicated by their x-co-ordinate. The data refer to a stretched specimen of air-dried kangaroo tail tendon, for which $c = 29{\cdot}4$ Å. The observed layer line spacings are shown on the right-hand side, and it will be noticed that they agree well with the calculated spacings, considering that the measurements are accurate only to about 5 per cent.

It is interesting that a reflection having a ξ value of approximately 0·20 is found in the fourth layer. The corresponding equatorial spacing is 7·7 Å and the absence of a reflection with this spacing in the zero-layer line has led to some authors[4] questioning the hexagonal unit cell proposed by Pauling and Corey.[5] The existence of this spot in the fourth layer supports the assumption of a hexagonal unit cell made by Ramachandran and Kartha.[1]

It is found that the intensities of the reflections found in the various layers could be explained if the helixes contain 10 residues in three turns, the spacing per residue being 2·94 Å. The intensities of the various spots which occur in the different layers are theoretically proportional to $J_n(2\pi R\xi)$,[6] where R is the radius of the helix and $J_n(z)$ is the Bessel function of z of order n, and n takes the values given by the equation

$$3n + 10m = l, \quad (m \text{ being integral}).$$

The smallest value of n which is operative for each layer is also given in Fig. 1. It will be seen that (*a*) for values of l from 3 to 10, practically all the expected layers occur, (*b*) all layers for which $n = 0$ or 1 are observed to occur, (*c*) the spots corresponding to $\xi = 0{\cdot}14$ occur only in layers having $n = 1$ or 0, and (*d*) when $n > 2$, no spots occur corresponding to $\xi < 0{\cdot}30$. These facts are in good agreement with what is to be expected from theory.

Further, the smallest ξ-value at which spots are observed in each layer can be used to determine the order of magnitude of the radius R of the spiral. This comes out to be of the order of 1 A. On examining the various helical structures proposed so far for collagen,[1,5,7-9] the only structure for which the radius of the helix is of this order is the one described from this laboratory.[1] The helix in that structure contains three residues per turn, while the above analysis of the X-ray data indicates that the helix should contain 3·33 residues per turn. It may be mentioned that the calculated density agrees much better with the experimental value with 3·33 residues rather than with 3 residues per turn. Thus, a small modification of the earlier structure would appear to be in good agreement with the X-ray and other data for collagen. Such a modification is not likely to affect the main features of the structure and the details are being worked out in this laboratory.

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DR. K. R. RAMANATHAN

DR. K. R. RAMANATHAN, Director, Physical Research Laboratory, Ahmedabad, and Chairman, Atmospheric Research Committee, has been elected President of the International Union of Geodesy and Geophysics at the Tenth General Assembly Meeting held in Rome recently. His election to this high office is a gratifying recognition of his services to meteorology for nearly three decades, and is particularly well-timed in view of the global programme for the Third International Geophysical Year now under way. The wide range of his interests is amply reflected in the variety of topics dealt with by him in his scientific publications; but among them special mention may perhaps be made of the study of thermal structure and movements of the upper air, in which field his contributions are outstanding. Our heartiest felicitations to him on the honour conferred on him.

ON THE NEED FOR A STUDY OF PHAENOCYTOLOGY

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INTRODUCTION

PHÆNOGENETICS is that branch of genetics which deals with the role of heredity in development. Being an offshoot of formal genetics,[1,2] the methods of inquiry in this field follow the pattern in vogue in the parent science. Application of Mendelian laws to problems in development can have only a limited significance so long as tissue differentiation remains enigmatic.[3] When accumulating evidence indicates that in many instances different tissues of the same organism have varying nuclear complexities[3,4] it behoves one to investigate whether these alterations, from the characteristic constancy in chromosome number in the indifferent cells of the early embryo, have a significance in regard to the origin of the different tissues themselves. It becomes necessary, therefore, to initiate a new field of endeavour, *viz.*, phænocytology.

Elucidation of the role of the nucleus can be attempted from two different directions. The rapid growth of microbial genetics has confirmed the belief that Mendelian laws are valid for all organisms. The morphological characters used in the formulation, analysis and establishment of the Mendelian laws are products of differentiation. Modern trends in cytology emphasize that nuclei undergo changes during differentiation.[4] The universality of the Mendelian laws would be valid only if the characters said to show segregation in microbes are of differentiated cells and the nuclei of which exhibit changes comparable to those undergone by indifferent embryonic cells when they become components of specific tissues. When the nuclear events during the formation of functional germ cells are considered vital to genetic segregation it should be obvious that nuclear phenomena during differentiation may be as significant to the expression of the characters segregated at meiosis.

The picture that emerges from the analysis presented earlier[3] is that during histogenesis, a variety of cytological changes occur in higher organisms. Assuming that what is witnessed is a regular doubling of the whole mitotic complement, it has been suggested[4] that these changes cannot be considered as responsible for differentiation since the same tissue shows more than one degree of endopolyploidy. A rational approach is to investigate whether the complexity assumed by the nucleus during the formation of a tissue is lost during dedifferentiation and a return to an indifferent condition. If it could be further shown, as in *Culex*,[5,6] that such dedifferentiated cells become endopolyploid when they again take part in the formation of another tissue, it would be legitimate to surmise that endopolyploidy may play an important role in differentiation. While the tissues of an organism are often products of irreversible differentiation, microbes are capable of differentiation and dedifferentiation.[7] Microbial cytology assumes, therefore, an unusual significance.

THE PROBLEM OF DIFFERENTIATION IN MICRO-ORGANISMS

For a correct appreciation of problems it becomes necessary to proceed on well established propositions. (i) The *differentiation-in-space* observed in multicellular organisms becomes one of *differentiation-in-time* in Protista[8] (p. 3). (ii) "The difference in behaviour of the nucleus during different times shows it to be subject to differentiation, as are the larger structures"[8] (p. 12). (iii) Meiosis has been reported in Protista.

It was indicated[3] that meiosis and endopolyploidy could be visualized as results of loss of synchronization in opposite directions, between chromosome reproduction and cytokinesis. Any claim of meiosis in Protista is an admission that one type of differentiation resulting from chromosome reproduction being out of step with cytokinesis does occur. Under the circumstances it would be rather strange if alterations in the nucleus do not occur when there is—as Darlington puts it—*differentiation-in-time*.

Endopolyploidy in Yeast.—When could an yeast culture be said to resemble embryonic or meristematic tissue[3] in its behaviour? Obviously two methods of approach are possible. In *Saccharomyces cerevisiæ* a fresh vegetative generation comes into being as a result of the germination of the zygote. The products of the first few divisions should resemble embryonic cells. An investigation of their cytology should reveal the real chromosome number of the strain. Such 'indifferent' cells become fermentative under anaerobic conditions or develop sculpturing when grown on solid media. These changes have been referred to as differentiations.[9–11]

But then, there are yeasts which are asporogenous. Some of them resemble the sporogenous types in their ability to ferment some of the sugars as well as develop sculpturing on

solid media. Sporogenous types themselves could be kept in the vegetative phase for a period of years. Any technique for the demonstration of mitosis in yeast should be capable of adaptation to sporogenous as well as asporogenous varieties. It may be recalled that bacterial cytologists—without offering a rationale—emphasize the use of *young* cultures alone for investigations.[12] It should be obvious, therefore, why Subramaniam[13] urged the use of young aerobically growing cultures for the study of mitosis in yeast.

Availability of mitosis as a 'standard' for evaluation rendered it possible to study variations in cytological behaviour under a variety of environmental conditions. The occurrence of endopolyploidy in yeast did not appear to us as something unique. Though the first report dealt with only fermenting cells,[14] it has been shown subsequently that yeast growing as agar streaks[15] or as giant colonies[16] are also endopolyploid. Thus the broad conclusion could be drawn that nuclear changes accompany differentiation in yeast.

Nuclear Changes in Protozoa.—Is such a conclusion valid for other micro-organisms as well? *Paramœcium,* for instance, possesses two nuclei subserving different but complementary functions. The micronucleus is solely concerned with reproduction as well as the replacement of the senile macronucleus. The macronucleus, on the other hand, is said to be intimately associated with the control of the physiological functions of the organism.[17] While Sonneborn[17] suggested that it is compound, Kimball[18] claims that it is polyploid. Since the macronucleus has only a limited span of life and in view of the distinction made between polyploidy and endopolyploidy,[3] it has to be considered as endopolyploid.

The situation is naturally different when we come to the uni-nuclear Protista. The same nucleus should have to alter its constitution and behaviour to changes in physiology. Many protozoan populations, free-living as well as parasitic, contain giant forms whose chromosome make-up is unknown. Wenrich[19] suggests that they may be polyploid individuals in view of the reported occurrence of endomitosis in *Barbulanympha* and his own observation of interrupted nuclear divisions in *Entamœba muris.* Apparently Wenrich is referring to the occurrence of endopolyploidy.[3] There is thus sufficient indirect evidence available to show that endopolyploidy may be as widespread a phenomenon in Protista, as it is in higher organisms.

Nuclear Changes in Bacteria.—Bacteria are no exception if some of the observations of Robinow[12] are viewed in the proper perspective. Each cell of *Bacterium coli* or *Proteus vulgaris* possesses only a single chromatinic structure or one or two pairs of these. With the aging of the culture, the appearance of enigmatic, atypical forms, possessing increasing numbers of chromatinic structures, has been reported. Robinow[12] gives a diagram where the atypical forms are arranged in an ascending grade of complexity (Fig. 3, p. 178). Judged in relation to the problem of dissociation[7]—not dissociation as understood in bacteria[20]—is it surprising that some of the descriptions of Robinow are reminiscent of the phenomenon of endopolyploidy?

The Problem of Dedifferentiation

When bacteria from old cultures show enigmatic chromatinic structures, does repeated subculture at short intervals produce a dedifferentiation and a return to an 'indifferent' condition? Is that the rationale for the use of *young* cultures for cytological investigations? The same problem is met with in yeasts also. It is possible to demonstrate normal mitosis in asporogenous yeasts like *Candida*[21] and *Rhodotorula*[22] by culturing them under optimal conditions of aeration and nutrition. Obviously the problem of dedifferentiation in yeast can be investigated only after an extensive survey of the cytological changes that accompany differentiation. This is what has been attempted in this laboratory during the past one decade. The stage is thus set for a planned analysis of the cytological changes that occur during dedifferentiation.

Though generally not realized, fertilization itself is a classical example of dedifferentiation. The functional germ cells like the sperm and ova are transformed cells and as such have only a limited span of life.[3] Fertilization brings about a loss of differentiation and a return to the indifferent condition. After a short or long period of mitotic proliferation, these cells begin once again to differentiate in an integrated fashion into the various tissues and organs of the adult organism.

Dissociation and Dedifferentiation.—The integration seen during development is very precise. "But it seems to be a very important, if perhaps insufficiently appreciated fact, that these fundamental mechanisms are not separable only in thought; on the contrary, they can be dissociated experimentally or thrown out of gear with one another"[7] (p. 505).

We saw earlier[3] that normal dissociation of the mechanism of mitosis results in meiosis and endopolyploidy. It would be desirable, there-

fore, to make a distinction between 'dissociation' and 'dedifferentiation'. Just because it is possible to throw out of gear experimentally the integrated mechanisms, it does not mean that a tissue may be capable of regular dedifferentiation. Cultures of different tissues may look alike under particular conditions. For example, cells of the liver are not capable of being transformed into those of the kidney and *vice versa*. Under proper conditions, the cells of the respective tissues do take up their specific functions. These apparent dedifferentiations have been classified under a separate category known as 'modulations'.

Cytology of Dedifferentiation.—Interest in the dynamic aspects of cytology is yet to develop. The only solitary instance where a detailed study has been made of the cytology of dedifferentiation is in the ileum of *Culex*.[5,6] Endopolyploid cells undergo somatic reduction and thus return to an indifferent condition as a prelude to their subsequent transformation into fresh tissue.

Reversible and Irreversible Differentiations.—Regular dedifferentiation can take place only when there has been a uniform duplication of all the chromosomes as in *Culex*. On the contrary, if there has been (*i*) loss of chromosomes, (*ii*) differential reproduction of chromosomes, or (*iii*) differential reproduction of regions of chromosomes during histogenesis,[3] such changes by their very nature lead to irreversibility. In lower organisms, with enormous powers of regeneration, differentiations appear to be reversible. With a rise in the evolutionary ladder there is a concomitant loss of the power of regeneration. It is tempting to inquire, therefore, whether such a loss is the consequence of irreversible changes in the nuclei.

Dedifferentiation in Yeast.—Wort cultures left standing for years are said to contain viable cells.[23] Since in a fermenting culture most of the cells are endopolyploid, two possibilities for the persistence of viable cells have to be considered: (*a*) unmodified cells capable of normal mitosis may continue to persist in such cultures; (*b*) endopolyploid cells may dedifferentiate and return to an indifferent condition. In a liquid culture, the cells become fermentative when anaerobiosis sets in. As a prelude to fermentation it is that the cells become endopolyploid. Naturally, therefore, it is difficult to visualize the persistence of indifferent cells in such cultures. Are the viable cells the result of dedifferentiation of endopolyploid cells?

The discovery of the peculiar type of "somatic reduction",[24] whereby a bud with the regular mitotic complement of two chromosomes originates from an endopolyploid cell, became interesting in this context. It appears to be a form of dedifferentiation. Such phenomena are seen in yeast cultures of varying ages from both solid and liquid media. It is a common experience that a loop of material transferred to fresh media results in the appearance of a fresh crop. The cells transferred show an ascending grade of complexity. The question arose whether the fresh crop is the result of proliferation of the indifferent cells alone or whether even the endopolyploid cells are capable of regular dedifferentiation. Recent investigations indicate that endopolyploid cells do return to the indifferent mitotic condition by a series of cell divisions unaccompanied by any simultaneous chromosomal reproduction.

It was shown earlier[3] that endopolyploidy can have a significance only in relation to differentiation and not to the hereditary make-up of the organism. The nuclear changes observed during differentiation and dedifferentiation in a micro-organism reinforces such a conclusion.

Is Endopolyploidy the Cause of Differentiation?

The critical surveys presented enable the formulation of some basic principles on the basis of which problems in Phænocytology could be approached. These are: (1) Differentiation is common to both unicellular and multicellular organisms. (2) The nucleus is capable of undergoing modifications. (3) Functional germ-cells like components of tissues and organs are products of differentiation. (4) Organization and integration of changes are seen not only during development but also in cells undergoing differentiation. (5) Dissociation of nuclear from cytoplasmic events could be in different directions.

Ideas regarding the significance of endopolyploidy are yet to crystallize.[25] As a consequence there appears to be a tendency to treat the phenomenon as a mere corollary to histogenesis.[4,26] Each tissue of *Gerris* is said to show a specific degree of complexity. "Thus, the nuclei of the tracheal epithelium were diploid or tetraploid, those of fat body tetraploid, octoploid and 16-ploid; those of œnocytes up to 128-ploid, while in the salivary glands Geitler found giant branching nuclei which were estimated from their volume and from the number of X chromosomes, to be 512-ploid, 1,024-ploid and even 2,048-ploid"[26] (p. 210). Attention is invited to the fact that the highest complexity is observed in salivary glands. Secretory cells show visible evidences of their activity. As a prelude to the appearance of secretory granules there is hypertrophy of the cytoplasm, the mitochondria, the Golgi apparatus and the nucleus.[27]

It is such cells which show a high degree of endopolyploidy. In the context of the limited span of life of secretory cells, the changes in their nuclei can have a significance only to the functioning of the cells and not to the genetic make-up of the organism.

From his survey, Huskins[25] arrives at the conclusion, that endopolyploidy may be a device enabling quantitatively different gene action in different tissues. Proceeding on similar lines Schultz[28] is faced with a dilemma. While there is no valid reason for postulating equal rates of reproduction during endopolyploidy, anything contrary to the above would necessitate the assumption of differences of quantity of genes, and hence of the genic balance, in different tissues and organs. When there is differential reproduction not only of chromosomes constituting the mitotic complement, but of even parts of individual chromosomes,[3] differences in genic balance are naturally to be expected.

A New Synthesis

The problem of endopolyploidy has not up till now been analysed as an aspect of the general phenomenon of dissociation between nuclear and cytoplasmic events during differentiation. An enormous literature on the different aspects of meiosis being available, it is possible to proceed from the known to the unknown. There are three different orders of changes during meiosis. When the unit of dissociation is the whole mitotic complement, regular reduction in chromosome number could be expected. If, on the other hand, it is the chromosome that is the unit, polysomy and aneuploidy would be the result. It may so happen that a specific region of a chromosome may be the unit. The 'misdivision' of the centromere resulting in the formation of an isochromosome is a typical illustration of this type of change.[29] Attention is invited to the fact that reproduction of a region of a chromosome could be in a direction entirely different from that of the rest.

The same three categories of events could be recognized during histogenesis also. When the consequences of the different types of dissociation during meiosis have a significance to the hereditary make-up of the succeeding generation, it would indeed be surprising if analogous changes during histogenesis can have no meaning to the origin of different tissues and organs.

Indifferent Mitotic Cells

↓

Meiosis ← —— Dissociation —— → Endopolyploidy

Units of dissociation

	Chromosome complement	Individual chromosome	Region of a chromosome
Meiosis ..	Regular reduction	Polysomy Aneuploidy	Misdivision Isochromosome
Endopolyploidy ..	Regular duplication *e.g. Culex*[5,6]	X and Autosomes 512-ploid. Y 4-ploid, *e.g.* Nurse cells[24]	Heterochromatin and granules in bands of salivary chromosomes[29]

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LETTERS TO THE EDITOR

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TOTAL CROSS-SECTIONS FOR NUCLEAR SCATTERING

THE optical model of the nucleus, proposed by Fernbach, Serber and Taylor[1] has been used to account for the nuclear scattering of nucleons at various energies. Such a model is defined by a certain nuclear density distribution and characterised by a complex refractive index written as

$$n = 1 + (\bar{k}_2 + i\bar{K}/2)\rho/k \qquad (1)$$

where ρ is the nuclear density distribution and $\bar{k}_1$ and $\bar{K}$ are independent parameters while k is the nucleon momentum. Usually a uniform density distribution has been employed. However, recently Gatha, Shah and Patel[2] have used the radial distribution method for analysing the nuclear scattering of 340 Mev. nucleons and obtained a characteristic nuclear density distribution for light elements described by

$$\rho(\bar{r}) = N \sum_{q=1}^{3} a_q \exp(-\beta_q \bar{r}^2) \qquad (2)$$

where

$N = 0{\cdot}066 \times 10^{13}$ cm.$^{-1}$,
$a_1 = 3{\cdot}77 \times 10^{26}$ cm.$^{-2}$, $\beta_1 = 28{\cdot}94 \times 10^{26}$ cm.$^{-2}$,
$a_2 = 2{\cdot}94 \times 10^{26}$ cm.$^{-2}$, $\beta_2 = 3{\cdot}83 \times 10^{26}$ cm.$^{-2}$,
$a_3 = 1{\cdot}50 \times 10^{26}$ cm.$^{-2}$, $\beta_3 = 0{\cdot}75 \times 10^{26}$ cm.$^{-2}$,

and

$$\bar{r} = r \times A^{-1/3}.$$

Using the above density distribution the present authors have derived an expression for total scattering cross-section in the first Born approximation. This is given by

$$\sigma_t = \bar{K}A + \lambda(\bar{k}_1^2 - \bar{K}^2/4)A^{4/3} \qquad (3)$$

where

$$\lambda = 0{\cdot}016 \times 10^{27} \text{ cm.}^{-2}$$

Using the experimental values of σ_t as given by Nedzel,[3] we have calculated the parameters of the complex refractive index through a least

square computation using equation (3). This gives $\bar{K}$= 34 mbn and $\bar{k}_1$ = 6 mbn. The value of $\bar{K}$ is close to the value of 33·6 mbn for the total cross-section of hydrogen as expected, while the value of $\bar{k}_1$ is close to 7 mbn. given by Jastrow's model for nucleon-nucleon interaction. In the present investigation we have used the above parameters and compared the experimental values of σ_t with the theoretical values as shown in Table I.

Since the total cross-sections for 315 Mev. protons for light elements have been recently measured,[4] we have also investigated the validity of the above expression at this energy.

We obtain $\bar{k}_1 = 9$ mbn from Jastrow's hard core nucleon model which is supported by the data at 340 Mev.[2] Moreover, the absorption parameter $\bar{K}$ is given by

$$\bar{K} = (\epsilon/2)\ \{\sigma_{np} + \sigma_{nn}\} \qquad (4)$$

We can regard the exclusion factor ϵ equal to unity at such a high energy. Using the experimental values of σ_{np} = 32·5 mbn and $\sigma_{nn} = \sigma_{pp}$ = 24·3 mbn, we have taken $\bar{K}$ = 28 mbn. The calculated values for the total cross-section using these parameters are also given in Table I, together with the experimental values of σ_t.

TABLE I

Total cross-section in millibarns

Element	400 Mev. neutrons		315 Mev. protons	
	Th.	Exp.	Th.	Exp.
Be ..	230	232	217	229±6
C ..	297	298	286	292±6
O ..	381	379	374	379±10
Al ..	590	588	607	580±16
S ..	677	681	708	686±18
Cl ..	..	..	750	740±20

The above comparison shows that the characteristic density distribution for light elements and the parameters of the complex refractive index given above provide reasonable values for the total cross-sections for this scattering process.

M. G. Science Institute, Ahmedabad-9, *June* 24, 1954.

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G. Z. SHAH.

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RELIABILITY OF THE SEMI-EMPIRICAL MASS FORMULA IN THE CALCULATION OF NEUTRON BINDING ENERGY

A RELIABLE determination of the neutron-binding energy is essential for the study of nuclear structure. As experimental data are lacking for various nuclei, it is worthwhile calculating the neutron-binding energies from semi-empirical atomic mass formula and compare the results with the experimental data wherever available.

Let M (Z, A) denote the mass of the atom of atomic number Z and mass number A, and M_0 (Z, A), the mass of the bare nucleus. Then M (Z, A) = M_0 (Z, A) + mZ, m being the electronic mass. We have then,

$$M_0\ (Z, A) = M_0\ (Z, A-1) + M_n - B_n\ (Z, A) \qquad (1)$$

where M_n is the mass of the neutron = 1·00898 and B_n (Z, A) is the neutron-binding energy in mass units. Using atomic masses, we have

$$M\ (Z, A) = M\ (Z, A-1) + M_n - B_n\ (Z, A) \qquad (2)$$

or B_n in Mev. is given by

$$B_n\ (Z, A) = 931{\cdot}15\ [M\ (Z, A-1) + M_n - M\ (Z, A)] \qquad (3)$$

where M (Z, A) is given by the Fermi-Weisacker semi-empirical atomic mass formula.[1] Using the above results, neutron-binding energies have been calculated in the range Z = 81 to Z = 85 and N = 123 to N = 131 where N is the number of neutrons. The results are given in Table I.

TABLE I

Neutron-binding energy of nuclei in Mev.

N \ Z	81	82	83	84	85
123	5·941 (6·57)	6·146 (6·49)	..	..	..
124	7·058 (7·48)	7·254 (8·15)	..	..	..
125	5·708 (6·23)	5·904 (6·68)	..	6·313 (6·71)	..
126	6·807 (6·88)	7·012 (7·37)	7·207 (7·44)	7·403 (7·77)	..
127	5·466 (3·87)	5·661 (4·34)	5·866 (4·17)	6·062 (4·56)	..
128	6·574 (5·08)	6·770 (5·20)	6·965 (5·09)	7·151 (6·01)	..
129	5·242 (3·2)	5·429 (3·79)	5·633 (4·31)	5·829 (4·81)	..
130	..	6·527 (5·31)	6·723 (5·31)	6·918 (5·87)	7·105 (5·89)
131	..	5·214 (3·36)	5·410 (4·08)	5·596 (4·57)	5·801 (4·7)

The experimental values are given within parentheses and are taken from the work of Kinsey[2,3] and Harvey.[4]

A few points arise from the examination of the calculated values. The calculated values of B_n for $N \leqslant 126$ are nearly in agreement with experimental data. But for $N > 126$ the difference between the experimental and the estimated values increases and ranges from 1·1·5 Mev. or nearly 25-40 per cent. The reason is that when a neutron shell is complete ($N = 126$), the nucleus becomes particularly stable and hence B_n should decrease. This observation corresponds to the view already expressed by many workers.[5-8] Thus the semi-empirical mass formula which is based upon a nuclear model without shell structure is not reliable in giving the binding energy after the completion of the nuclear shell.

Dept. of Physics, M. MOHIUDDIN.
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A FORMULA FOR THE K- AND L-ABSORPTION DISCONTINUITIES

SEVERAL empirical relations have been suggested for the magnitude of the K absorption jump ratio (r_K):

(*a*) by Jönsson[1]

$$r_K = \lambda_{L_1}/\lambda_K = E_K/E_{L_1} \qquad (1)$$

where E_K and E_{L_1} are the energies of K and L_1 states respectively.

(*b*) by Rindfleisch[2]

$$r_K = aZ^b \qquad (2)$$

with $\log_{10} a = 1{\cdot}805283$; $b = -0{\cdot}6207$.

(*c*) by Laubert[3]

$$r_K = a\lambda_K^b \qquad (3)$$

with $\log_{10} a = 0{\cdot}857652$; $b = 0{\cdot}0843$.

(*d*) by Tellez-Plasencia[4]

$$r_K = (a' + bZ)^{-1},$$

which he writes as

$$Q_K = 1 - \frac{1}{r_K} = a - bZ \qquad (4)$$

where $a = 1 - a'$. By putting $a = 0{\cdot}948833$ and $b = 0{\cdot}0024882$ a good agreement is obtained with the experimental values. Plasencia further showed that analogous relations of the various described forms can also be given for the L-absorption jump ratios.

In view of the fact that the data for various elements available from different workers are distributed over a wide range, it is difficult to decide in favour of any one of the suggested relations. However, in the absence of any satisfactory theoretical treatment of topic, a selection can be made on the ground of its agreement with the experimentally well established general formula.

$$\tau_a = CZ^p\lambda^n \qquad (5)$$

for the true atomic absorption coefficient, neglecting the scattering.

In (5) the values of C and p change at critical absorption wavelengths. The value of n remains independent of the branch of the curve because the curves on the logarithmic plot may be taken to be parallel. Therefore, for the K-discontinuity it is possible to write

$$\tau_a = CZ^p\lambda^n, \text{ for } \lambda < \lambda_K$$

and

$$\tau_a' = C'Z^{p'}\lambda^n, \text{ for } \lambda_K < \lambda < \lambda_L$$

where λ_K and λ_L denote the K- and L-absorption limits respectively. Regarding τ_a and τ_a' to be the absorption coefficients close to the K-absorption discontinuity on the short and long wavelength sides respectively, it is possible to write the K-absorption ratio as

$$r_K = \tau_a/\tau_a' = (C/C')Z^{p-p'}$$

Putting $a = C/C'$ and $b = p - p'$, we have $r_K = aZ^b$ which is of the same form as the relation (2) employed empirically by Rindfleisch to represent r_K. In view of the accepted form of the relation between τ_a, Z and λ the form (2) for r_K appears to be the most rational one.

The author wishes to thank Dr. G. B. Deodhar for his kind interest in this work.

Dept. of Physics, BIPIN KUMAR AGARWAL.
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BAND SPECTRUM OF TUNGSTEN OXIDE

IN continuation of the work of one of the writers on tungsten oxide in the Astrophysics Laboratories of the Vatican Observatory,[1] further work is undertaken. In addition to the bandheads of WO reported to have been obtained by Foster and Gaydon[2] and partly analysed by A. Gatterer and S. G. Krishnamurthy,[1]

new data were obtained from photographs of the infra-red region taken in the Spectroscopy Laboratories of the Imperial College, London (by S. G. K.) and of the visible region at low and high currents (two and twenty-three amperes) taken in this laboratory (by V. V.).

Four new systems of bands have been found starting with $\nu\nu$ 12911·0, 14160·8, 16073·3 and 21226·9 as the (0, 0) bandheads of the corresponding Deslandres schemes. Two of these, photographed in this laboratory from two ampere and twenty-three ampere arcs, are given below.

v' \ v''	0	1075·5	1	1088·2	2
0	16073·3(6) 971·7				
1	17045·0(4)		15969·5(4) 979·0		
2			16948·5(3)		15860·3(3)

v' \ v''	0	1066·4	1	1057·8	2
0	21226·9(5)		20165·8(2) 965·9		
1			21131·7(3) 974·2		
2	23177·6(2)		22105·9(3) 938·1		21048·1(2)
3			23044·0(2)		

Physics Dept., V. VITTALACHAR.
Presidency College, S. G. KRISHNAMURTHY.
Madras, *July* 9, 1954.

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NEW SEDIMENTS IN THE REWA SERIES (UPPER VINDHYAN SYSTEM) FROM SATNA DISTRICT, VINDHYA PRADESH*

THE following succession of beds has so far been recognised[1-3] in the Rewa Series (Upper Vindhyan System) in the Bundelkhand area: Upper Rewa sandstone, Jhiri shales, Lower Rewa sandstone, Panna shales and Rewa limestone.

While mapping in the erstwhile Baraunda State (now merged in Vindhya Pradesh and forming part of the Satna District), the present author discovered that in a part of this area in addition to the above horizons a succession of beds consisting of sandstones, shales and limestone occurs below the Rewa limestone and overlying the Kaimur sandstone. These beds total about 60′ in thickness and occur in perfect conformity with the overlying sequence. They have been traced over a distance of about 10 miles and an area of about 80 sq. miles.

A slight erosional unconformity between the basal limestone bed of this new succession and the Upper Kaimur sandstone is noticeable.

It is proposed to designate these newly discovered beds as the "Paisuni Stage" after the Paisuni river in whose valley they have been found to occur in great force. Thus, the Vindhyan succession in this area as established by the new survey is as follows:

Rewa limestone and the younger beds
Paisuni sandstone
Paisuni shales
Paisuni limestone
Kaimur sandstone

The Paisuni limestone, about 5′ in thickness, is greyish-green and buff in colour, and resembles the Rewa limestone in appearance. It forms the bottom-most horizon of the entire series and rests over the Kaimur sandstone. The overlying shales average about 35′ in thickness in the area covered so far. They are generally of chocolate and green colour, and are highly fragmented. In general, the Paisuni limestone and shales are very closely similar to the younger Rewa limestone and the Panna and Jhiri shales respectively; and if examined in isolated outcrops it is indeed difficult to distinguish between the two sets.

The thin-bedded Paisuni sandstone, about 20′ in thickness, found underlying the Rewa limestone is, however, lithologically different from the other sandstones found in the Rewa series. The typical Rewa sandstones are indurated, compact and white or pink-coloured, while the Paisuni sandstone is a softer, somewhat loose-grained, greenish coloured and slightly foliated rock. The green colour is due to the presence of chlorite. Fine specks of muscovite are also observed. This sandstone is much softer than the other Rewa sandstones and is a distinguishing feature of the Paisunis.

It appears that these beds occupy a much larger area than the Baraunda territory and their outcrops extend eastwards into the Banda District of Uttar Pradesh. Systematic mapping on regional basis will reveal the full extent of their outcrop.

A detailed account and geological map of these formations in the type area will be published in due course.

I am indebted to Dr. A. G. Jhingran, Geological Survey of India, for his active encouragement.

Geological Survey of India, S. M. MATHUR.
Lucknow, *May* 21, 1954.

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* Published by permission of the Director, *Geological Survey of India*.

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PIEDMONTITE FROM ROBERTSONPET, MYSORE

PIEDMONTITE, the rare manganese member of the epidote group, was first reported in Mysore by the present author.[1] It has been studied in greater detail from its optical and chemical points of view and the results of the study are set forth in the present paper.

Piedmontite is fairly well developed in the champion gneiss at its contact with the hornblende schist in two localities near Robertsonpet, namely, 1 furlong south of Kemputhimmanahalli (78° 17′ 34″ : 12° 56′ 17″) and 3 furlongs east of Masika (78° 17′ 0″ : 12° 56′ 28″). The optical study of a number of grains of the mineral reveals that $X \wedge C = -5°$ and $2V$ varies between 75° and 80° with an average value of 76°. The optical characters of the mineral, as compared with those described by Short[2] and Simonson[3] from California, are as follows :

Robertsonpet (Mysore)	Madera County California	Los Angles County California
X = pale lemon yellow	X = Orange yellow to lemon yellow	X = orange yellow to lemon yellow
Y = pale amethyst	Y = amethyst to amethystine red	Y = amethystine red
Z = pale red	Z = carmine	Z = carmine
$\gamma - \alpha = 0{\cdot}029$	$\gamma - \alpha = 0{\cdot}060$	$\gamma - \alpha$ = High
$X \wedge C = -5°$	$X \wedge C = -4$ to 5°	$X \wedge C = -3$
$2V = 75$ to 80°	$2V = 64$ to 75°	$2V = 70$ to 80°

It is seen from the above comparison that the Mysore mineral agrees generally with the Californian minerals in its optical characters. It is significant, however, that the birefringence of the Californian minerals is very high, nearly twice as compared with that of the Mysore mineral.

A powder of this mineral, obtained by Thoulet solution, was analysed by Sri. T. D. Bhaskar, Central College, Bangalore, and it was found to contain 12·5 per cent. Mn_2O_3, which is very similar to the Mn_2O_3 content (12·13 per cent.) of piedmontite from Madera County,[4] California. On plotting the optical characters, $2V$ and $X \wedge C$ and Mn_2O_3 content of the Mysore mineral in the variation diagram proposed by A. M. Short[5] for piedmontites, it is seen that the values fit into the $X \wedge C$ and $2V$ curves perfectly. Short, in his study of piedmontites from California, showed with the help of the variation diagram that excess of manganese increases $2V$ and $X \wedge C$ and decreases the indices of refraction. In this connection he observed, "From data recorded by Larsen and from Anderson's conclusions, it is very probable that the N_g and N_p curves converge with increase of Mn_2O_3, but not enough data are available to justify a definite statement".[6] The Mysore mineral, like the piedmontite from Madera County, California,[7] occurs replacing biotite in a metamorphosed volcanic rock and thus agrees very closely with the latter not only in its mode of occurrence but also generally in its optical and chemical characters.

The author desires to express his indebtedness to Sri. L. Rama Rau and Dr. C. S. Pichamuthu for valuable suggestions and to Sri. T. D. Bhaskar for determining the manganese content of the mineral.

Dept. of Geology, M. G. CHAKRAPANI NAIDU.
Central College, Bangalore,
July 24, 1954.

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RESOLUTION OF MIXTURES OF AMINO ACIDS BY CIRCULAR PAPER CHROMATOGRAPHY*

ASIDE of the method of separation of amino acids by two-dimensional chromatogram, there are so far only two methods for this purpose, using the uni-dimensional technique. Redfield and Barron[1] have developed a method for the separation of a mixture of 18 amino acids, which

* After this communication was submitted for publication, there has appeared in the July issue of this Journal a note by Krishnamurthy and Swaminathan indicating the method for the separation of amino-acids by buffered circular paper chromatography.

requires the use of seven different solvents. McFarren[2] has achieved the separation of amino acids by using six solvents buffered at different pH in seven different chromatograms. In an earlier communication,[3] it has been shown as to how a mixture of amino acids can be analysed by circular paper chromatography. Subsequently, it was realised that the method was fairly time-consuming and not quite easy of adoption for routine work. The problem of the resolution of a mixture of amino acids by circular paper chromatography has been, therefore, further investigated, and it has been found that a mixture of amino acids can be resolved, as given below, in three different chromatograms by using (1) *n*-Butanol saturated with water at 20° C., (2) a mixture of *n*-Butanol, water, acetic acid in the proportion of 40 : 14 : 5 and (3) a mixture of *n*-Butanol, water, acetic acid in the proportion of 40 : 5 : 15. The method, in brief, is as follows. 5 μl of the solution (pH 6-7) of amino acids, prepared in the concentration of 0·05 per cent. in 10 per cent. isopropanol, is spotted on the circumference of a circle of 1" radius, which is drawn at the centre of a filter circle of 9" radius. This big size circle is cut out from a Whatman Paper No. 1, which has been previously chromatographically washed, first with N/100 hydrochloric acid and then twice with distilled water. After air-drying the spot, the chromatogram is run at 18-20° C., till the solvent boundary reaches the periphery of the paper. This takes about 16-18 hours. At the end of this period, the chromatogram is removed and dried in the air. In the case of solvents I and III, after drying, the chromatogram is run again, and this procedure is followed once more. The accompanying photographs of sectors of chromatograms illustrate the order in which the amino acids separate. Thus, it can be seen that, in the absence of α- and γ-amino butyric acids, leucine, isoleucine, phenylalanine, tryptophan, tyrosine, proline, alanine, threonine, hydroxy-proline, histidine and arginine are separated with solvent I (Fig. 1), phenylalanine, valine, methionine,

FIG. 1. Solvent used; Butanol saturated with water at 20° C. Number of runs : Three. Time of each run : 18 hours. Order of Separation :

L–IL–Ph–Va–Try-α-AB Pr–Al–Th–Hpr–Gly–Hi–Ag–AA
| | | | | |
Me Ty γAB Se Ly
| |
Glu Or
|
Cy

FIG. 2. Solvent used : Butanol–Acetic acid–water (40 : 5 : 14). Number of runs : One. Time of run : 16 hours. Order of Separation :

L–Ph–Va–Me–Try–Ty–Pr–Al–Th–Hpr–Gly–Ag–Or–Cy
| | | | |
IL Glu Se Hi Ly
|
AA

tryptophan, tyrosine, proline, alanine, hydroxyproline and cystine are separated with solvent II (Fig. 2), and methionine, threonine, glutamic acid, hydroxyproline, glycine, serine, aspartic acid, arginine, ornithine and cystine are separated in solvent III (Fig. 3). Except lysine, all the remaining amino acids can be separated in three separate chromatograms with these three solvents. Lysine, however, can be separated, if ornithine is eliminated from the mixture, when it will come as a separate band above cystine in a chromatogram run with the solvent II.

The method has been employed for the quantitative estimation of amino acids in edestin hydrolysate. The details of the work will be published shortly.

The authors wish to thank Dr. M. Sirsi for

FIG. 3. Solvent used: Butanol–Acetic acid–water (40 : 15 : 5). Number of runs: Three. Time of each run: 17 hours. Order of Separation:

L–Ph–Me–Pr–Al–Th–Glu–Hpr–Gly–Se–AA–Ag–Ly–Or–Cy
IL Va Ty Hi
Try

his kind help, and Professor M. S. Thacker, Director, Indian Institute of Science, Bangalore, for his keen interest in the work.

Section of Pharmacology, N. A. N. RAO.
Indian Inst. of Sci., T. K. WADHWANI.
Bangalore-3, *July* 13, 1954.

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VOLTAMMETRIC ESTIMATION OF LEAD WITH POTASSIUM FERROCYANIDE

IN a previous publication[1] the precipitation of $Pb_2Fe(CN)_6$ in the voltammetric titration of lead solutions with potassium ferrocyanide was reported. The work has since been extended with a view to use this titration for the quantitative estimation of small amounts of lead.

The manual polarographic arrangement[2] using dropping mercury electrode (D.M.E.) was employed. Dissolved oxygen was eliminated from the solutions by bubbling purified nitrogen. The supporting electrolyte was 0·1 M KNO_3, and every 50 ml. of the lead solution to be titrated contained 0·5 ml. of 0·05 per cent. gelatine solution as a maximum suppressor. The titrations were carried out at D.M.E. potential of − 0·55 volt *vs.* S.C.E. where the diffusion current in the cathodic reduction wave of Pb^{++} has a limiting value. Potassium ferrocyanide is not reduced at the D.M.E.[3] Titrations of 0·001 to 0·008 M solutions of Pb^{++} have been carried out. The titration curves were L-shaped. Table I gives a typical set of observations.

TABLE I

Voltammetric titration of lead nitrate with potassium ferrocyanide

Volume of lead nitrate solution = 50 ml.; E.M.F. applied = − 0·55 volt *vs.* S.C.E.; Temperature = 30° ± 0·1° C.

Strength of $Pb(NO_3)_2$ soln.	Strength of $K_4Fe(CN)_6$ soln.	Calculated titre value in ml.	Observed titre value* in ml.
0·0010 M	0·0250 M	1·000	1·000
0·0016	0·0250	1·600	1·607
0·0016	0·0499	0·802	0·810
0·0020	0·0499	1·002	1·005
0·0040	0·0999	1·001	0·997
0·0056	0·0999	1·401	1·405

* Mean of three observations. The individual titres were within 0·01 ml. of the mean values

The method enables estimation of Pb^{++} within an error of 1 per cent. and can be employed even in presence of Ba^{++} and Ca^{++} which complicate the estimation of lead as oxalate, chromate or sulphate.

Thanks are due to Prof. R. P. Mitra for his interest in the work.

Chemistry Dept., BALDEV KHOSLA.
University of Delhi, HARISH C. GAUR.
Delhi, *August* 14, 1954. N. A. RAMAIAH.

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CHROMOSOME NUMBERS IN SOME SPECIES OF THE GENUS *ALYSICARPUS* NECK.

THE genus *Alysicarpus* belonging to the family *Papilionaceæ* consists of a number of species widely distributed throughout Africa, Asia, Australia and the American tropics. In Index Kewensis and its supplements, 31 species of this genus are listed of which 13 are stated to occur in India. Cooke's *Flora of Bombay Presidency* records 9 of the Indian species in the Bombay State, where they are found usually growing in grass lands and are used as forage. In the course of botanical and agronomic studies in progress at this laboratory on the available species of fodder value, the chromosome numbers were counted in six species of the genus occurring in Bombay

State. The chromosome numbers are given below as the first count in the genus.

Seeds from plants grown and identified were used for chromosome counts. I am indebted to Rev. S. J. Santapau of St. Xaviers College, Bombay, for confirming the specific nomenclature. The seeds were germinated after treatment with strong sulphuric acid for 15 minutes. Well-grown root-tips were fixed, blocked and cut. Karpechenko's fluid was used for fixation after a trial with different fixatives. The staining was with crystal violet. Chromosome counts were made from intact cells. The somatic number $2n$ is 16 in all the six species, *viz.*, (1) *Alysicarpus-buplurifolius*, D.C. (2) *A. longifolius*, Wight and Arn, (3) *A. monilifer*, D.C., (4) *A. pubescens*, Law, (5) *A. rugosus*, D.C. and (6) *A. vaginalis*, D.C. In the species, *A. vaginalis* a variety *nummularifolius* also has sixteen chromosomes.

Cytogenetical Lab., H. K. SHAMA RAO.
College of Agriculture,
Poona, *April* 20, 1954.

ORGANIC ACIDS IN BANANAS

CHARACTERIZATION of non-volatile organic acids in bananas has been a subject of controversy. Corenwinder[1] ascribed the acidity in banana as due to malic acid and this was confirmed by Wehmer[2] while working with the green fruit. Bigelow and Dunbar[3] generalized that banana contained only malic acid. The presence of citric acid along with malic acid was reported by Hartmann and Hillig,[4] but this was contradicted by Harris and Poland[5] who concluded that the total titratable acidity of the fruit is accounted by 1-malic acid. Minute quantities of oxalic acid were traced in plantain[6-7] and also in ripe bananas.[8] Fonseca[9] detected citric, malic, boric, tartaric, acetic and butyric acid in the two varieties of Brazilian bananas. The presence of tartaric acid in the ripe fruit[8] and glycosuccinic acid in unripe fruit[10] has also been reported. Since most of the earlier work pertained to the Gros Michael variety of banana, it was considered desirable to extend the work to indigenous varieties with a view to determining whether any fresh acid could be detected.

100 g. of the pulp made into paste was extracted with 200 c.c. of 80 per cent. alcohol on a cheese cloth. The extract was centrifuged and made alcohol free on a water-bath and made upto a known volume. The organic acids present in the extract were studied by ascending paper chromatographic technique using butanol-formic acid-water (10 : 2 : 5) as solvent and bromo-cresol-green as spraying reagent. For each variety green and ripened stages were selected and, in all, nine different varieties listed below were examined.

1. POOVAN—*Musa sapientum* Linn. var. Poovan.
2. CHAKKARAKELI (Syn. *Raja Vazhai*) *Musa sapientum* var. *Chakkarakeli.*
3. PACHABALE—*Musa cavendishii* Lamb. var. *Pacha vazhai.*
4. CHANDRA BALE—*Musa sapientum* Linn. var. *Chenkadali.* (Syn. *Chandrabale*).
5. RASABALE—*Musa sapientum* Linn. var. *Rasthali.*
6. KADA BALE—*Musa balbisiana* Colla. *Clone Kade bale.*
7. NENDRA BALE—*Musa sapientum* Linn. var. *Nendran.*
8. PEYAN—*Musa sapientum* Linn. var. *Peyan.*
9. MADURANGA—*Musa sapientum* Linn. var. *Monthan.* (Syn. *Madhuranga bale.*)

The chromatogram readings revealed that all the abovementioned varieties of banana, contained citric acid and 1-malic acids as the only non-volatile organic acids. Both of these acids were found in ripened as well as unripened stages of the fruit. The identification of these two acids was confirmed by chemical tests. The chemical tests carried out for acetic, boric, tartaric, oxalic and butyric acids were found negative in all the indigenous varieties of banana.

The authors' thanks are due to Dr. V. Subrahmanyan for his keen interest in the work, and to Shri T. Gopalan Nayar for assistance in assigning botanical names for the banana varieties.

Central Food Tech. Res. Institute, B. S. LULLA. D. S. JOHAR.
Mysore, *July* 26, 1954.

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NEW OBSERVATIONS ON THE AFFERENT BRANCHIAL SYSTEM OF *HETEROPNEUSTES FOSSILIS* BLOCH, (ACTINOPTERYGII; OSTARIOPHYSI; SILUROIDEA)

DURING investigations on the respiratory system of Indian fresh-water fishes it was noticed that no satisfactory account of the circulation in this region exists in literature on the subject. In regard to the afferent branchial system in *Heteropneustes fossilis*, the sketch and account by Burne[1] does not show either the origin or the opening of these arteries. Neither do Das[2] and Hyrtl[3] give any adequate description of this system. A remarkable new type of arrangement of these arteries, which has not been reported before in any Indian fish, is reported here.

It was observed that three pairs of afferent arteries, the second, the third and fourth, all originate from the same opening on the roof of the ventral aorta (Af. b. 2nd, 3rd and 4th, Fig. 1). The ventral aorta, immediately after

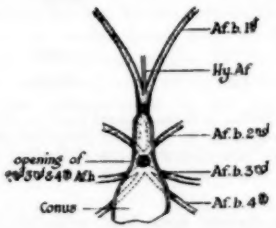

FIG. 1. Afferent branchial arteries in *Heteropneustes fossilli*.

piercing the pericardium, gives off two branches: one directed forwards and the other backwards. The forwardly directed branch divides into two immediately after it is given out, to form the second pair of afferent branchial arteries. While the second branch, which is backwardly directed, also divides into two, and each one of them in turn divides into two—the third and fourth afferent branchial arteries of the right and left sides. The third and fourth afferent arteries *of each side* thus arise from a common root. The two common roots of the third and fourth afferent arteries arise in turn from the single aperture from which the common root of the second pair of afferent branchial arteries also originate. Thus, *six arteries* (the right and left, second, third and fourth afferent branchial arteries) in all originate from the ventral aorta by a single opening and thus have *one common root*.

On the other hand, the first pair of afferent branchial arteries (Af. b. 1st) are formed separately by the forking of the ventral aorta in level with the ventral end of the first branchial arch. Before the ventral aorta divides into the first pair of afferent branchial arteries, it gives out a single median artery supplying the hyoidean arch. This artery has been named as the hyoidean afferens (Hy. Af.), after the region it supplies.

It is possible that this peculiar origin and arrangement of the afferent branchial arteries in *Heteropneustes fossilis* (as in *Ophicephalus striatus*, Das and Saxena[4]) is correlated with the air-breathing habit of the fish. Further work is in progress and details will be published later. My grateful thanks are due to Dr. S. M. Das of Lucknow University under whose guidance the work is being carried out.

Dept. of Zoology, D. B. SAXENA.
The University, Lucknow,
August 2, 1954.

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ON THE DERMAL GLANDS OF SOME INDIAN SCORPIONS

IN most arthropods the cuticle is usually perforated vertically by numerous prominent ducts arising from special epidermal cells called dermal glands. Wigglesworth[2] suggested that the role of the dermal glands was to form the outermost layer of the cuticle, namely, the outer epicuticle which may be formed shortly before or shortly after moulting.

In *Palamnæus swammerdam*, Krishnan[1] described prominent dermal gland ducts which arising from the hypodermis opened externally to the amber layer of the cuticle. It, therefore, appears from his account as well as from his diagrams that these stop short beneath the epicuticle and do not open to the exterior. These have been reported to contain Sudan IV staining lipoids which presumably are discharged into the epicuticle. In the illustrations given by Krishnan[1] the dermal glands appear to be unicellular and are studded with some granules.

During an investigation on the cuticle of the arthropods the writer observed that in *Palamnœus bengalensis* similar prominent dermal gland ducts of about 8 μ in diameter pierced the hard cuticle (Fig. 1, 4). These arise from the

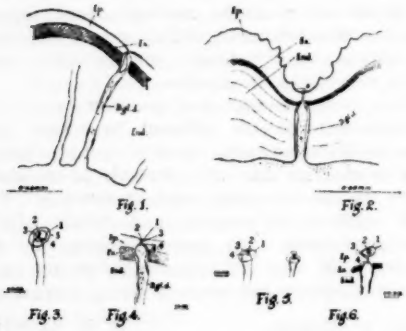

Fig. 1. Fig. 2. Fig. 3. Fig. 4. Fig. 5. Fig. 6.

FIG. 1. T.S. cuticle of *Palamnæus bengalensis*. FIG. 2. T S. cuticle of *Buthus tamulus gangeticus*. FIG. 3. Opening of a dermal gland of *Palamnæues bengalensis* as seen in whole mount. FIG. 4. Opening of a dermal gland of *Palamnæus bengalensis* as seen in transverse section. FIG. 5. Opening of dermal gland of *Buthus tamulus gangeticus* as seen in whole mount. FIG. 6. Opening of dermal gland of *Buthus tamulus gangeticus* as seen in transverse section. *Ep*, Epicuticle. *Ex*, Exocuticle. *End* Endocuticle. *D. gl. d*, Dermal gland duct. *S*, Dried secretion. 1. Depression in epicuticle. 2. External opening. 3. Canal in epicuticle. 4. Projected rim of dermal gland duct. 5. Opening in exocuticle.

flask-shaped gland cells in the hypodermis and traverse the entire endocuticle and exocuticle. These ducts at first sight also appear to end blindly into the epicuticle as presumably described for *Palamnæus swammerdam*, but careful examination of a large number of sections revealed that the openings usually observed corresponded actually to the rim formed by the exocuticular material surrounding the ducts. The real opening in *Palamnæus bengalensis* lies in a shallow depression on the outer surface of the cuticle and is in communication with the dermal gland duct below through a fine ductule in the epicuticle. It is seldom that the sections pass through this ductule without being slightly oblique and that is why most of the sections do not show the actual opening. The structures observed in transverse sections were verified and compared by the writer from an examination of a whole mount of the cuticle under changing focus of the microscope (Figs. 3, 5). The distribution of the dermal glands occurs roughly about 100 per sq. mm. although this distribution may not be uniform all over.

In another scorpion, *Buthus tamulus gangeticus*, examined by the author similar dermal glands were found to be present in the cuticle. Their position and course is more or less the same as in *Palamnæus bengalensis*. The external opening here lies in a special pit and the ductule is very long (Figs. 2, 5, 6). The cuticle here is also thrown into denticular projections. The distribution of these glands, though not uniform, occurs slightly less per sq. mm. as compared to that in *Palamnæus bengalensis*.

In freshly cut unstained sections these dermal gland ducts appear to be filled up with violet-coloured and vacuolated cytoplasm studded with some granules (Figs. 7 and 8).

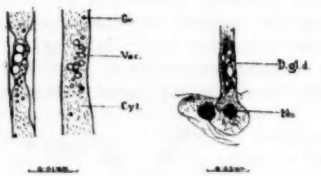

Fig. 7. Fig. 8.

FIG. 7. Portion of dermal gland ducts to show vacuolated cytoplasm. FIG. 8. A dermal gland cell of *Palamnæus bengalensis*. *Gr.*–Granule. *Vac.*–Vacuole. *Cyt.*–Cytoplasm. *Nu*, Nucleus of dermal gland. *D. gl. d*, Dermal gland duct.

These are stained deep blue with Mallory, Delafield and Heidenhain hæmatoxylin and there is evidence that these are discharged to the exterior (Fig. 6). A blue staining material can sometimes be seen extending from the duct into the ductule in the epicuticle or as glandular exudation which often accumulates on the orifice of the duct. The writer did not get evidence for the presence of any material staining with Sudan IV in these dermal gland ducts.

Further work is in progress. My thanks are due to Dr. M. B. Lal for guidance. Thanks are also due to Scientific Research Committee, Uttar Pradesh, for providing funds to carry out the work.

Dept. of Zoology, S. C. SHRIVASTAVA.
The University, Lucknow,
June 12, 1954.

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BLOSSOM BLIGHT OF *ZANONIA INDICA* LINN.

A BLIGHT of blossoms of *Zanonia indica* Linn. due to *Choanephora cucurbitarum* (Berk. & Rav.) Thaxt. was observed at Dacca in September 1953. The above disease has not been reported so far on any species of *Zanonia*. The earliest indication of the disease is the appearance of minute brown spots on the petals. These spots rapidly enlarge and turn black, involving the entire corolla and the calyx. During moist weather the affected flowers appear soft and rotting, but under dry conditions they appear only withered and discoloured. As the disease progresses the discolouration and the rotting extend down into the pedicels and the rachis. The affected flowers ultimately become covered with a brilliant crop of silvery white conidiophores.

Sporangia, sporangioles and zygospores not observed on host, developed in monosporic cultures. The conidiophores and conidia produced in cultures were similar in shape and size to those found on the host.

Inoculation of the inflorescence with conidial suspension in water gave positive results, the symptoms developing within 24-36 hours. The organism was reisolated from the infected tissues. The inflorescence in the control series remained free from disease.

Thanks are due to Prof. G. P. Majumdar for the facilities accorded for work.

Dept. of Biology, SYEDA HUSNE ARA.
University of Dacca, K. A. MAHMUD.
Dacca, *July* 13, 1954.

BEHAVIOUR OF TAPETAL CELLS DURING MICROSPOROGENESIS OF *LENS ESCULENTA* MOENCH.

Two main types of tapetal cells have been recorded, the secretory type in which the cells remain *in situ* without breaking their walls, and the amœboid type in which cell-walls are dissolved and the contents of the cells wander in the pollen sac. In *Lens esculenta* the tapetal cells show an intermediate behaviour. The innermost wall layer of the anther acts as tapetum and its cells remain uninucleate throughout their life. By the time uninucleate pollen grains are formed in the anther, the walls of the tapetal cells are dissolved and the contents of the tapetal cells form a peripheral layer around the microspores instead of wandering in the pollen sac (Fig. 1). This tapetal periplasmodium which forms a peripheral layer round the microspores disappears by the time binucleate pollen grains are formed. Dnyansagar[1] reported an intermediate behaviour of

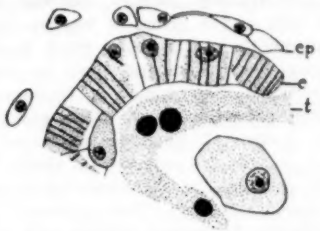

FIG. 1. T. S. anther. Note epidermis (*ep*) is degenerating, endothecium (*e*) has acquired fibrous thickening and tapetum (*t*) has formed periplasmodium at the periphery of the anther locule, × 74·1.

tapetal cells in *Adenanthera pavonina* Linn. but in this case the tapetal cells loose contact with each other and migrate between the groups of mother-cells. Such a behaviour of tapetal cells as observed during the course of present investigation has not been recorded so far.

I am highly thankful to Dr. Bahadur Singh for kind guidance.

Dept. of Biology, T. C. SHUKLA.
A. S. Jat College, Lakhaoti,
Bulandshahr, *July* 15, 1954.

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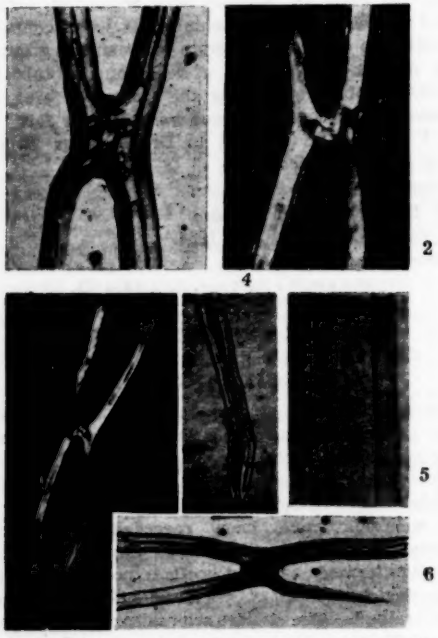
NATURE AND OCCURRENCE OF SEPTA IN FOLIAR SCLEREIDS OF *SCINDAPSUS* SP.

IN the course of studies on the foliar sclereids in monocotyledons the author noticed the presence of thin septa in certain foliar sclereids of *Scindapsus pictus* Hassk. and *S. officinalis* Schott., belonging to Araceæ.

Sclereids have been recorded in certain members of Araceæ.[1-3] They have been variously termed as bast cells,[4] polls,[1] internal hairs,[5] trichoblasts,[6] "Sclereiden"[2] and tricho sclereids.[3] The foliar sclereids of *Scindapsus* are disposed in a more or less parallel manner inside the lamina, do not show any relationship with veins and are peculiar in having processes resulting in H-shaped forms. They do not form regular strands but leave considerable spaces between them. They are of three types: thick and fusiform, H-shaped and others of variable size and shape. The fusiform sclereids are variable in length and sometimes branched at the ends (Fig. 4). The cell walls are thick and striated and possess a narrow lumen which is sometimes occluded. The

pits are prominent and canal-like in the thick sclerosed wall. The H-shaped forms are remarkable for their conspicuousness. They attain considerable lengths, possess a thick striated wall and a broad or narrow lumen of irregular width. The arms vary in lengths, their ends are fusoid and may be branched, and sometimes their lumen is occluded. The third type comprises very much elongated or arrested forms of variable size and shape. There is a strong tendency to attain the H-shape as revealed by the existence of a series of intergrading forms. They possess a slightly or moderately thickened striated cell wall and a broad or narrow lumen of irregular width. A noteworthy feature is the presence of septa in the lumen (Figs. 1, 5 & 6) which is filled with



Ordinary (Figs. 1, 4 and 5) and Polarised light between crossed Nicols (Figs. 2, 3).

FIG. 1. H-shaped sclereid with septa in the lumen, × 225.

FIGS. 2 and 3. H-shaped sclereid reveals the double refraction of the cell wall, × 225 and × 125.

FIG. 4. A fusiform sclereid with branched tip, × 125.

FIG. 5. A portion of fusiform sclereid showing broad septate lumen, × 225.

FIG. 6. H-shaped sclereid showing a broad or narrow lumen of irregular width, × 125.

air or ergastic substances, and occasionally crystals. De Bary[5] reported the occurrence of a few thin septa in the lumen of the 'internal hairs' of Aroideæ. They give a negative reaction to cellulose tests. Under crossed nicols they are completely cut out, resulting in a dark field at all positions of the stage whereas the striated secondary cell wall exhibits a birefringence (Figs. 2, 3) and undergoes extinction four times during the complete rotation of the slide on the stage (detailed account of septa formation will appear elsewhere). The septate sclereids are similar to some fibre cells, which later become septate as reported by Vestal and Vestal[7] in *Hypericum androsæmum* and by Spackmann and Swamy[8] in many other dicotyledons. Most of the sclereids in seed plants are non-septate, whereas the fibres which are of common occurrence in many dicotyledons are septate. Thus we have in *Scindapsus* sp. sclereids resembling fibres and fibres resembling sclereids. This further emphasises the difficulty of distinguishing one from the other.

I wish to thank Prof. P. Maheshwari for going through the manuscript.

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Biology Dept.,
Gujarat College, Ahmedabad,
June 14, 1954.

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MYCETOMES AND SYMBIOTES IN *LEPTOCORISA VARICORNIS* FABR. (COREIDAE, HEMIPTERA)

ASSOCIATION of micro-organisms with certain insects of the order Hemiptera was discovered as early as 1892 by Forbes.[1] Later Glasgow,[2] Kuskop,[3] Rosenkranz[6] and Schneider[7] worked on the nature and possible method of transmission of these micro-organisms from one generation to another. The location of these organisms or symbiotes as they are called, in their hosts may be extra- or intra-cellular.

Two rows of sac-like cæca are attached to the wall of fourth ventriculus of the midgut of *Leptocorisa varicornis* (Fig. 1). Similar

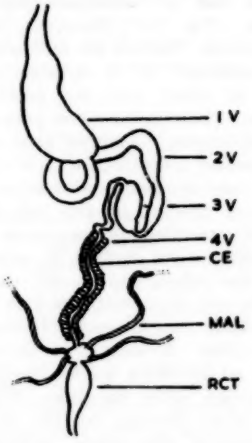

FIG. 1. Intestine of *Leptocorisa varicornis* F. showing mycetomes. CE, mycetomes or cæca; MAL, malpighian tubes; RCT, rectum; 1 V—4 V, ventriculus of midgut.

structures in other insects have been termed as 'gastric cæca' or 'bacterial crypts' but here they will be referred to as mycetomes which is now a widely accepted term for such special organs harbouring symbiotes. The size, shape and nature of symbiotes vary in different insect species. They may range from minute cocci to large spirochætes and from yeast to protozoa. In *Leptocorisa varicornis* they are minute rod-shaped bacteria, 1-1·5 μ long, which can readily be seen in mycetomic smears stained with Giemsa (Fig. 2). A study

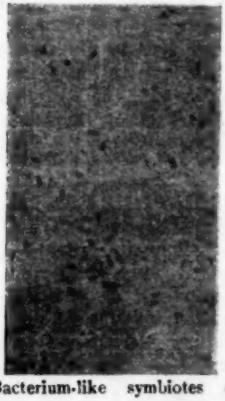

FIG. 2. Bacterium-like symbiotes of *Leptocorisa varicornis* F.

of smears of other parts of intestine shows that bacteria are present in enormous numbers only in the mycetomes and not elsewhere. There appears to be only one type of bacteria in the mycetomes.

Very little is known about the physiology of symbiotes found in insects. Only in a few cases like those of *Lasioderma serricorne* and *Stegobium paniceum*,[4] and *Rhodnius prolixus*[8] have they been found to supply some of the factors of vitamin B complex. In termites[5] they aid in digestion. Nothing, however, is known regarding the exact function of bacteria of *Leptocorisa varicornis*, but in the light of the recent researches in insect-microbiology there is reason to assume that they may perhaps be of some importance in nutrition or digestion. This of course requires further studies, which are in progress.

I wish to thank Dr. M. L. Bhatia, Head of the Zoology Department, Delhi University, for providing me with facilities for research.

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KARYOTYPES IN *DIPCADI* MEDIC.

THE genus *Dipcadi* consists of about 45 species,[3] most of them being found in tropical South Africa, a few in Southern Europe, tropical Asia and Madagascar. Hooker,[4] recording six species in India, writes "The Indian species want a thorough re-examination, with far better materials than I have access to". Blatter and McCann[1] have added two new species, *viz.*, *D. saxorum* Blatter and *D. ursulæ* Blatter from Bombay and Panchgani respectively. Chromosome numbers are known only in two species: *D. serotinum* and *D. glaucum*, with $2n = 8$ and $2n = 18$ respectively.[2] There has been, however, no work done in India on any of the Indian species. Therefore, it seemed desirable to investigate this genus thoroughly from the view-point of morphology, cytology and embryology, as it was felt that it may throw

some light on the interrelationships of the Scilloideæ to which tribe it belongs.

Such a study was undertaken by us and in the present paper a brief account of the karyotypes in three species, *viz.*, *D. montanum* Baker, *D. saxorum* Blatter and *D. ursulæ* Blatter, is given.

The root tips were raised from the bulbs and they were fixed in Lewitsky's fluid. The usual paraffin method was followed and sections were cut at 14 μ.

D. montanum has the diploid number of chromosomes as $2n = 20$ (Fig. 1). The chromosomes are fairly long except for the three pairs which are comparatively short. Two pairs of long and one pair of medium-sized chromosomes have sub-median constrictions. The rest have sub-terminal constrictions. Two pairs are noticed with satellites. There is, however, one pair with secondary constrictions not noticed in the other two species.

FIG. 1. *Dipcadi montanum.* Somatic metaphase showing 20 chromosomes.
FIG. 2. *Dipcadi saxorum.* Somatic metaphase showing 12 chromosomes.
FIG. 3. *Dipcadi ursulæ.* Somatic metaphase showing 20 chromosomes.
All Figures × 1,800.

In contrast with the other species, *D. saxorum* has a low number of $2n = 12$ (Fig. 2). Except for one pair of chromosomes which are very short, the rest are all long. In this species all the chromosomes have sub-terminal constrictions. Sub-median constrictions found in the other species are not noticed. There are, however, two pairs of chromosomes with satellites.

D. ursulæ, like *D. montanum*, has $2n = 20$ chromosomes (Fig. 3). However, its karyotype differs from that of *D. montanum*. The diploid complement in *D. ursulæ* consists of four pairs of short and six pairs of long chromosomes. There is only one pair with sub-median constrictions. Another pair has somewhat sub-median constrictions. All the other pairs have sub-terminal constrictions. As in the other two species, in this also there are two pairs of satellited chromosomes.

Of the three species studied, *D. saxorum* differs from the other two in its chromosome number. Though *D. montanum* and *D. ursulæ* have the same chromosome number, their karyotypes differ. However, it is of interest to note that all the three species have two pairs of chromosomes with satellites. This, apparently, has some bearing on the evolutionary tendencies within the genus, but too much stress cannot be laid on this point at present as other species have not been available for study.

As regards distribution, *D. montanum* has a comparatively wider range, occurring from Rohilkund in the north to Belgaum in the south, whereas *D. saxorum* and *D. ursulæ* are endemic to small areas in Bombay and Panchgani respectively. Detailed papers on the cytology and embryology of these species will appear elsewhere.

We are thankful to Mr. P. S. Chikkannaiah for supplying the material.

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EFFECT OF SULPHUR FERTILIZATION ON THE PUNGENCY OF ONION

FOUR doses of elemental sulphur (commercial grade) replicated six times in randomised blocks were employed as fertilizer—one week after transplanting onion seedlings in the first week of November. The usual cultural operations were carried out and the bulbs were harvested in the first week of April. Pungency was measured by estimating the volatile sulphur

content of the bulbs, by the method described by Platenius.[1] Fresh weight and dry weight measurements on the bulbs harvested from the differently treated plots were also made.

TABLE I

Effect of sulphur fertilization on increase of pungency in onion bulbs

Sulphur applied as fertilizer	Volatile sulphur in the onion bulb in P.P.M.	Average fresh weight per bulb	Dry matter %	Pungency (smell) in 3 month stored samples
Zero ..	134·4	80·3 g.	8·97	+
50 lb./acre ..	200·0	97·4 g.	9·43	++
100 lb./acre ..	280·0	100·4 g.	10·05	+++
200 lb./acre ..	336·0	96·3 g.	10·11	+++
400 lb./acre ..	352·0	86·7 g.	9·99	++

+ denotes presence of pungency; ++ denotes medium pungency; +++ very pungent.

Table I indicates increase in volatile sulphur content of bulb with increase in elemental sulphur fertiliser. However, the rise is much less in the higher doses than in the relatively lower ones. Pungency as diagnosed by intensity of smell does not agree entirely with the upward trend of volatile sulphur content in the bulb.

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TWO NEW SPECIES OF *SYNCHYTRIUM* FROM BIHAR

BUTLER collected a number of species of *Synchytrium* in Bihar some of which were recorded by Butler and Bisby.[1] Lacy[2] and Mishra[3,4] have described a few species recently. The author collected some species of *Synchytrium* in the monsoon of 1953 two of which were found on examination to be undescribed. An account of these species proposed as new is given below.

1. *Synchytrium micranthum* sp. nov.

Galls on leaves, numerous, crowded together presenting warty appearance, distinct, simple, orange yellow, turning brownish. Sporangial sori, orange yellow, polygonal, thin-walled, smooth, surrounded by several layers of elongated rectangular host cells forming the gall, measuring 68·5-145·8 μ, average 128·5 μ in diameter. Sporangia about 100-150 in number, hyaline to yellow and 22·2-35·9 μ, average 28·4 μ in diameter. Resting spores numerous, associated with sporangial sori ovate to spherical, thick-walled, greyish-brown, dispersed in several layers of the gall tissue, measuring 55·5-142·2 μ, average 107·5 μ in diameter.

Hab. on leaves and stems of *Micranthus oppositifolius* Wendl., Begusarai, Bihar, 23-10-1953, Leg. G. P. Singh.

Micranthus oppositifolius Wendl., a member of Acanthaceæ, is a weed commonly found in orchards and along the roads. Plants of different ages were found infected with the fungus. Prominent galls were produced on both surfaces of the leaves but mostly on the lower surface where they were aggregated towards the mid-ribs, veinlets and the pedicels. On the stems, galls were lodged mostly in the ridges.

2. *Synchytrium cessampelum* sp. nov.

Galls on leaves and stems, pale yellow turning brownish, simple, minute, inconspicuous, mostly aggregated near veins on the leaves. Resting spores spherical, thick-walled, greyish yellow with greyish oil reserve, covered over with a single layer of thin-walled elongated epidermal cells, measuring 16·3-68·8 μ, average 45·8 μ in diameter. Prosori and Sporangia not observed.

Hab. on the leaves and stems of *Cessampelos pareira* Linn. Hazipur, Bihar, 4-9-1953, Leg. G. P. Singh.

Cessampelos pareira Linn. is a medicinal plant of the family Menispermaceæ. Infection spots on the leaves and stems were minute and not easily distinguishable in the field. In dry specimens it becomes still very difficult to locate the galls. Cook[5] described *Synchytrium cocculi* on *Cocculus carolinus*, a member of the same family but his species differs in all the essential features from the fungus described here.

Further studies on the life-history of these fungi are in progress.

The writer wishes to acknowledge his indebtedness to Dr. J. N. Mishra, for his valuable suggestions and encouragement.

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MEGASPOROGENESIS AND MEGAGAMETOPHYTE DEVELOPMENT IN *COMBRETUM OVALIFOLIUM* ROXB.

Two types of development of megagametophyte have been described in the genus *Combretum*. For instance, Mauritzon[1] reported the formation of a 16-nucleate megagametophyte of the Peperomia type in two species of *Combretum* (*C. pincianum* and *C. paniculatum*) and Venkateswarlu[2] reported the development of a 8-nucleate megagametophyte of the Polygonum type in *C. coccineum* (*Poivera coccinea* DC). The present note deals with megasporogenesis and development of megagametophyte in *Combretum ovalifolium*.

The ovary is inferior, unilocular and usually contains two ovules which are bitegmic, crassinucellate and anatropous. Megasporogenesis proceeds normally and the megaspore mother cell forms a linear tetrad of megaspores (Fig. 1). The chalazal megaspore functions, the other three degenerate (Fig. 2). The development of the megagametophyte corresponds to Polygonum type. The egg apparatus is made up of two synergids and the egg. The synergids show a filiform apparatus. The two polar nuclei are usually situated below the egg. The antipodals degenerate early (Figs. 3, 4, 5). At certain stages of megagametophyte development, the nuclei of the gametophyte were found to disintegrate (Fig. 6).

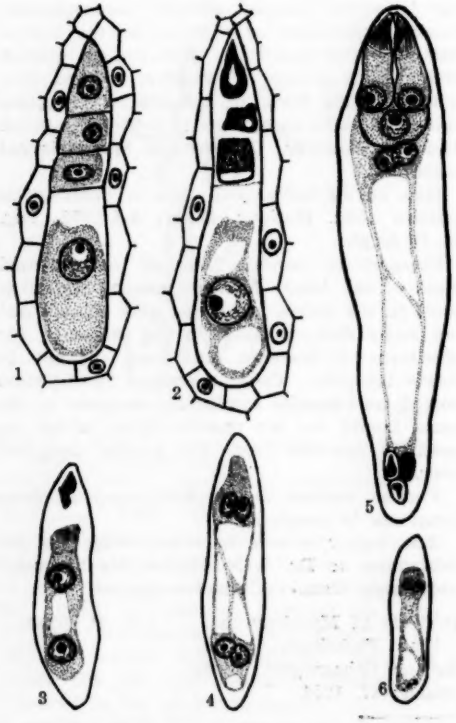

FIG. 1. A linear tetrad, × 320.
FIG. 2. A linear tetrad showing the chalazal megaspore developing and the other three degenerating, × 320.
FIG. 3. Two-nucleate megagametophyte, × 160.
FIG. 4. Four-nucleate megagametophyte, × 160.
FIG. 5. Eight-nucleate megagametophyte, × 160.
FIG. 6. Four-nucleate megagametophyte with two chalazal nuclei degenerated, × 70.

My sincere thanks are due to Prof. L. N. Rao for kind encouragement.

Dept. of Botany, M. NAGARAJ.
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PHYLLOSTICTA CYCADINA (PASSER) ON *CYCAS REVOLUTA*

ALTHOUGH Chibber reported *Phyllosticta cycadina* on *Cycas* sp. from Poona for the first time in India, symptoms were not described and pathogenicity not established by him. Infected portion of a leaflet first become yellowish, later changing to light brown. In a large number of cases, the disease starts from the tip proceeding towards the base but in some, it appears as irregularly distributed brown spots. Finally, the infected portion from the tip becomes ash-coloured and may develop black pycnidia, which are more numerous on the lower than on the upper surface. The ash-coloured portions with or without pycnidia get crumpled and fall off, the whole process taking about 4-5 months. The disease is more marked from October to February.

Isolations from the infected regions invariably gave *Phyllosticta cycadina*. The pathogenicity was tested on *Cycas revoluta*, *C. rumphii*, *Cladium* sp., *Dracœna* sp., palm, *Canna indica*, *Chenopodium album* and *Solanum nigrum*, but it was found to infect *Cycas revoluta* only. Symptoms similar to those observed in nature were produced by artificial inoculations, only when sufficient moisture was available. The disease appeared earlier if the inoculations were made in the evening but the process was slower whenever the inoculations were made in the morning. The first symptoms of the disease appeared 8 days after inoculation, provided moist cotton pads were regularly placed for 4 days. They appeared after 12 days when the plants were kept in the

moist chamber, but not at all if sufficient moisture was not maintained near the inoculum. The infection was earlier during winter and on the fifth day, the mycelium could be traced inside the host tissues. No infection developed on the uninjured upper surface, but the disease appeared without any injury on the lower surface. This difference may be due to the presence of thick cuticle on the upper surface as against numerous stomata on the lower surface. Sections revealed that except in the injured regions, the fungus generally entered through the stomata.

Asthana[1] suggested that Diathane or Cuprovit reduced the incidence of disease but not fully. Ramakrishnan[2] and Choudhury[3] found that leaf-spot diseases caused by *Phyllosticta* could be controlled with Bordeaux mixture. The present disease was not, however, amenable to it. Many mercurial and copper fungicides were tried at various intervals, both before and after artificial inoculations. Copper sandoz and Tillex were found more effective than any other but even these could not control the disease fully. Dusting within three days of inoculation gave more efficient control. The detailed results will be published in due course.

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NOBEL PRIZE FOR MEDICINE, 1954

THIS year's Nobel Prize for Medicine and Physiology has been awarded jointly to Drs. John F. Enders, Thomas Weller and Frederick Robbins, Poliomyelitis specialists at the Children's Hospital in Boston.

Dr. Enders is Associate Professor of Bacteriology and Immunology at the Harvard Medical School and Director of the Research Division of Infectious Diseases at the Children's Medical Centre, Boston. He was born at West Hartford on February 10, 1897. In World War I, Dr. Enders was a first lieutenant in Marine Aviation Corps. In World War II he served as Army Consultant on Epidemic Diseases. He was the recipient of Rassano Found Award for culturing poliomyelitis virus in living tissue in 1953.

Dr. Weller of the Harvard School of Public Health, and Dr. Robbins, a classmate of Dr. Weller at the Harvard Medical School, have been actively collaborating with Dr. Enders in his researches on poliomyelitis.

Dr. Enders in collaboration with Dr. Weller and Dr. Robbins developed a technique for growing polio virus in what was known as the "roller tube method". Before the work of Dr. Enders and his associates, it was practically impossible to produce polio vaccine in required quantity because of the dearth of the necessary isolated virus. They discovered that the virus could be grown *in vitro* or bits of living tissue taken from human beings or monkeys. This provided a rapid and simple method for identifying different types of polio virus and for establishing whether a person has been infected.

During 1949, when the author visited their laboratory at Boston, they were using the embryonic tissue of freshly delivered still-born babies for the cultivation of polio and other viruses. The embryonic tissue is cut up into very small bits and a solution (modified Tyrode) is added to the embryonic tissue. Usually, penicillin (to prevent contamination) is also incorporated into the fluid medium. This tissue medium is inoculated with the virus material and incubated in flasks at 35° C. The fluid is renewed every 3 or 4 days and pooled and inoculated into mice, to assess the potency of the virus.

Prior to the work of Drs. Enders, Weller and Robbins, polio could be developed only in living monkeys. Virus obtained from infected monkeys was contaminated with monkey nerve tissue, from which it could not be successfully separated. A vaccine prepared from such contaminated virus was not considered suitable to be used as a prophylactic against poliomyelitis.

The new technique constitutes, therefore, a landmark in medical history. Since it was first announced in 1949, it has become one of the most effective weapons in the fight against polio and a host of other virus infections.

Y. S. NARAYANA RAO.

REVIEWS

Scientific Papers Presented to Max Born. (Oliver & Boyd), 1953. Pp. vi + 94. Price 12 *sh.* 6 *d.*

Ten essays written by some of the foremost physicists adorn the volume under review and are offered as a tribute to Professor Max Born on the occasion of his retirement from the Tait Chair of Natural Philosophy. The list of contributors—Appleton, Bohm, de Broglie, Courant, Einstein, Jordan, v. Karman, Lande, Schrödinger and Weyl—itself bears ample testimony to the high esteem in which Born is held by theoretical physicists. As is to be expected, the topics of the essays are wide and varied. The article by Appleton on the influence of the earth's magnetism on the ionosphere, and that of v. Karman and Penner on the theory of explosive flames are the only ones which deal with experimental aspects of physics.

In a thought-provoking article (in German) Einstein examines the interpretation of the fundamentals of quantum mechanics, and some of his remarks have been critically discussed by Bohm. These and the articles of de Broglie on the interpretation of wave mechanics, of Lande on probability in classical and quantum theory, and of Schrödinger on relativity and wave-mechanics, all deal with the advancing front of contemporary physics. There is a very interesting paper by Jordan on the application of probability concepts of atomic physics in biology, particularly in relation to mutation and polyploidy. The two purely mathematical papers are by Courant on the classification of partial differential equations and by Hermann Weyl on the passage from complex numbers to numbers of an arbitrary field. The volume also contains a bibliography of Prof. Born's publications.

In a work of this character, the topics selected by the various contributors, being a reflection of their current interests, must range over a fairly wide field; it is, however, significant that four of the papers deal with various aspects of the probability interpretation of quantum mechanics, which was due in its original form to Professor Born himself. These papers constitute a definite contribution to the understanding of a fundamental point in contemporary physics, and richly deserve to be studied by every serious student of physics.

Text-Book of Metallurgy. By A. R. Bailey. (Macmillan & Co., London), 1954. Pp. viii + 560. Price 30 *sh.*

This book sets out to cover the whole field of metallurgy usually prescribed for university students. It has six chapters devoted to physical metallurgy, six to process metallurgy and one each to testing of metals and temperature measurements. In this respect, the framework of this book differs somewhat from some established favourites. However, it is one of the best the reviewer has come across. The impression that with such a wide field to cover, the treatment would be highly abridged and extensive supplementary reading has to be made, is quickly dispelled. The treatment is adequate throughout and in some cases, as in binary alloy systems, exhaustive. The list of books for further reading, carefully selected and appended to each chapter, is very useful.

The first two chapters deal with the crystal structure and atomic structure of metals, the treatment in general following that of Hume-Rothery. These are followed by two chapters on binary alloys. There is then a chapter dealing with the effects of stress on metals and one on the physical examination of their internal structure. The chapters on ore-dressing and the extraction and refining of non-ferrous and ferrous metals and alloys are followed by two more on casting and shaping processes. The two concluding chapters are on the testing of metals and temperature measurements.

The treatment is throughout very clear. There are many line drawings, figures and photographs to help the student form a clear picture of what is explained. A number of binary equilibrium diagrams are given at the end and enable the student to form an idea at once of the complexity as well as versatility of many of these alloy systems. Detailed discussion of individual alloy systems is not possible in a book of this type and the author has wisely refrained from attempting to explain in detail even the metallography and heat treatment of steel. Although it is an advanced topic, the reviewer would have liked to see a short discussion on ternary

alloy systems and their representation, particularly because of the information given in Chapter 8 on free energy concepts and reactions in slag systems.

Not the least attractive feature of this book is the set of questions selected from university and other professional examinations, given at the end. This book will be most useful to students preparing for a first degree in metallurgy. It is neatly got up and its comparatively low price requires special mention.

E. G. RAMACHANDRAN.

The Insulation of Electrical Equipment. Edited by Willis Jackson. (Chapman & Hall, London), 1954. Pp. 340. Price 42 *sh.*

The book is a compilation of lectures, by different authorities in the field of insulation and dielectrics, delivered at a post-graduate vacation school to assist young men in the sphere of insulation design.

The first chapter deals with a historical survey of the development of electrical insulation. The insulation designer is constantly faced with a range of conflicting practical requirements. Such problems and the properties of insulants which are relevant to the resolution of these problems are discussed in brief in the first chapter.

The next three chapters deal with the structural basis of the electrical and mechanical properties of insulating materials and with the mechanism of dielectric permittivity, loss and breakdown. The deterioration in service of insulating materials due to various factors such as oxidation, moisture, thermal and electrolytic effects, ionic discharges, etc., are discussed. An outline discussion of certain aspects of the above relevant to the sphere of insulation design has been made in these chapters. Chapter 5 deals with the classification of insulating materials by the International Electrotechnical Commission on the basis of the above.

The next five chapters are devoted one each to the discussion of the insulating materials actually used in present-day designs of communication components, power cables and capacitors, electrical machines, transformers and switchgear. The behaviour of the insulating materials both under normal and adverse conditions are discussed and the reasons for using the different insulating materials and their limitations in use are dealt with. The extent to which the synthetic insulating materials have been used in place of those processed from naturally occurring products and their limited effect on the design have also been discussed. The chapter on insulation of power transformers deals mainly with core-type transformers. Suggestions have been made of the directions in which improvement in insulating materials and design would lie.

The last chapter deals with the important subject of insulation testing in the laboratory, factory and field. After dealing with the classification of tests in accordance with their functions, test methods and interpretation of test results are discussed. The author has laid emphasis on the fact that tests are not an end in themselves; they should be the means for determining fitness for service. He suggests that accepted tests should be reviewed regularly, while constantly bearing in mind the service conditions and, in particular, the time factor. A bibliography of up-to-date references of published literature is added at the end of each chapter.

The book provides a fundamental approach to the problem of the use and behaviour of insulating materials from the point of view of design and is bound to be useful to both design engineers and operating engineers.

C. S. GHOSH.

Introduction to Dynamics. By L. A. Pars. (Cambridge University Press), 1953. Pp. xxii + 501. Price 50 *sh.*

This is an elementary treatise on the dynamics of a particle and of rigid bodies, useful for the student who has some knowledge of elementary statics and calculus and is intended to serve as an introduction to advanced treatises such as that of Whittaker. The first two chapters deal with the algebra and calculus of vectors and the third chapter is an exposition of the fundamentals of Newtonian dynamics based on Newton's three laws of motion. The author has taken great care to show how the subsequent development of the subject depends on these laws.

Chapters IV to XVII deal with particle dynamics and the remaining nine chapters are devoted to rigid dynamics, without using Lagrange's equations. Vector methods are used sparingly only where a distinct gain in elegance is achieved thereby. Moreover, its scope is very limited in two-dimensional dynamics, and with the view of focussing the attention on principles rather than methods, the author has relied on the two well-known devices of repetition and of going from the simple and concrete to the more general and abstract. At

the same time, the proofs and ideas are set out in a rigorous and clear way. The principle of reversibility on page 78, impulsive motion and collision of particles in Chapter VIII, the motion of a particle of varying mass in Chapter IX, the two chapters on central forces and the Chapter XVIII on the kinematics of two-dimensional motion deserve special mention as they contain some modern ideas. Two-dimensional rigid dynamics also, within the limits self-imposed by the author, has been expounded in an admirable way so as to rouse the interest of the student in the subject.

A number of diagrams are given and suitable examples are worked out to illustrate the underlying principle and numerous problems (nearly 500) are given in a graded manner as exercises for the student. On the whole this is a very interesting and modern text-book on elementary dynamics.

T. R. RAGHAVA SASTRY.

Facts, Files and Action, Part II. (*Filing, Indexing and Circulation.*) By J. Edwin Holmstrom. (Chapman & Hall, London), 1953. Pp. xvi + 280. Price 32 *sh.*

The present volume is a logical sequel to Part I which dealt with the sources and backgrounds of facts (reviewed in this Journal 1952, 21, p. 145). In his introduction, the author observes that the documentation of facts for easy reference ought to be recognised as a profession in its own right, related to other professions in the same ancillary but vital way that librarianship is related to research or dietetics to hospital management. At present, however, it is only a few enlightened organisations that accord their registry or filing staffs a status and dignity commensurate with the importance of the key function they perform. Only by so doing is it possible to attract and retain men and women with the very special intellectual qualities needed to do it properly.

The varieties of methods available for filing and indexing which are dealt with in the book in the course of nine chapters will convince anyone of the truth of the author's remarks. Considering how very much the efficiency of an office, large or small, depends on proper integration and storekeeping of its records, it must be said that the author has rendered a distinct service by setting down the correct principles and rationale of these arts. The volume is heartily recommended for careful study and guidance by all those who have to rig up a system of artificial memory to make up for the shortcomings of the natural one.

Vapour Pressure of Organic Compounds. By T. Earl Jordan. (Interscience Publishers, Inc.), 1954. Pp. ix + 266. Price $ 14.50.

In the volume under review the author has compiled the available data on vapour pressure of organic compounds from the published literature and presented them in a very useful form for the ready reference of an industrial worker, chemist or a chemical engineer. The data has been presented in three different ways: (*i*) by giving tabulated values, (*ii*) by appropriate graphs of vapour pressures with respect to temperature, and (*iii*) by giving the mathematical relationships of the form $\log_{10} P = (A - B)/(c + t)$ connecting the vapour pressure with temperatures in most of the cases. Vapour pressure data compiled include those for hydrocarbons, halogen compounds, alcohols, aldehydes, ethers, ketones, oxides, esters, nitrogen compounds, phenols, and organic compounds containing arsenic, selenium, sulphur, silicon, antimony, boron, gallium, lead, phosphorus, tin, thallium, beryllium and zinc.

Mention here may be made of the magnificent volume *Selected Values of Physical and Thermodynamic Properties and Related Compounds*, by the American Petroleum Institute Research Product 44 published by Carnegie Press, Pittsburgh, Pa, 1953. Data given by T. Earl Jordan for hydrocarbons are in fair agreement with those of American Petroleum Institute Research Project.

The book is recommended as a useful addition to any research library and as a valuable asset to chemists and chemical engineers.

G. S. LADDHA.

Sexual Behaviour in the Human Female. By the Staff of the Institute for Sex Research, Indiana University. (W. B. Saunders & Co., Philadelphia, U.S.A.), 1953. Pp. xxx + 842. Price 50 *sh.*

It was Dr. Alfred C. Kinsey who first initiated the research programme on the sexual behaviour of *homo sapiens*, and the project has had the staunch and generous support of the Indiana University since its inception in 1938. A Report on the Sexual Behaviour of the Human Male was published in 1948, the present one being the second in the series. The volume is one of the most publicised documents to issue from any laboratory. It has also been widely reviewed in the lay press of the U.S.A. and elsewhere.

As a scientific treatise on what the laity might regard as the most delicate of subjects, the Report is a great classic of its kind and will

no doubt be much sought after by marriage counsellors, sex consultants and others. Dr. Kinsey and his associates have made the best use of available data, collected with great difficulty and under promise of the strictest secrecy.

Of the adverse criticisms against the Report and these were many, only one need detain us here, and this is: to what extent the Report may be considered as truly representative of the entire class it seeks to speak about? In regard to this point it may be categorically stated that no such pretensions were ever made by the authors of this Report, who have taken special care to avoid generalisations or conclusions, beyond what is perfectly defensible scientifically.

The volume is divided into three parts. The scope of the study and the methods employed in assessing the data on a scientific basis are indicated in the course of three chapters in Part I. Chapters IV to XIII on the types of sexual activity prevalent constitute Part II. Comparative studies of the anatomy, physiology, psychological factors, neural mechanisms and hormonal factors with reference to both the sexes are assigned a chapter each, and go to make up Part III of the volume.

As the authors themselves admit, a great deal more is yet to be known before pronouncements in regrad to sexual behaviour can be made with anything like the assurance possible in the physical sciences. But it cannot be gainsaid that a great beginning has been made here in this direction, and it is to be hoped that Dr. Kinsey and his associates will be given all the support and encouragement which they need to carry the project further and which, may we add, they have very well earned the right to expect, on the basis of these monumental Reports.

Yeast Technology. By John White. (Chapman & Hall), 1954. Pp. 431. Price 55 *sh.*

This book, consisting of 22 chapters, is based on a series of papers entitled "Principles and Practice of Yeast Production', published in the *American Brewer* and on papers published in the *Journal of the Institute of Brewing*. Each chapter is devoted to a particular aspect of yeast such as classification, nutrition, mechanism of growth, methods of estimation of activity and factors in the industrial processes, etc. It is well supplied with 59 detailed tables and 71 plates, drawn from various research papers and organisations. The references to the latest papers compiled at the end of each chapter provide a valuable source of information.

Most of the research work and the principles described in the book relate to the baking industry and the strain of Saccharomyces; but the study of the reactions of this strain of yeast to various treatments will be of value to workers in other fields also. Readers in the brewing and distilling industries will find specific interest in a chapter on Brewers' Yeasts by C. Rainbow and in Chapter XVII on the microbiological control of yeast growth processes.

More elaborate details with regard to the use of the yeast in the pharmaceutical, wine and distilling industries will present a complete picture.

This is a useful handbook of information for all workers in yeast research and industry.

E. N. PARTHASARATHY.

***Discovery Reports*, Vol. 26**, Nos. 1-8. (Issued by the National Institute of Oceanography.) (Cambridge University Press), 1954. Pp. vi + 354. Price 99 *sh.*

This volume which took over three years to complete, contains 8 articles from Robert Clarke, Hjalmer Broch, A. W. B. Powell, Grace E. Pickford, E. J. Iles and S. G. Brown and is illustrated by 62 text-figures and 18 plates.

Ceratias holbolli, an angler-fish with adjustable fish lure, was recovered from the stomach of a sperm whale. Its toxonomy and allometric growth (suggesting that this may be the adult of *Mancalias*) are discussed. Its being found at 1,000 m. in the tropics and at 120 m. in higher latitudes is likely to be due to factors of light intensity rather than temperature, and therefore it is not likely that the cold Polar current forces it to the surface. Species of stylasterid corals from the antarctic are described. The study of antarctic and subantarctic pelecypods and gastropods shows that the bulk of them could have been derived from those of the Americas and that the occurrence of stenothermic gastropod genera like *Aforia* and *Fusitriton* of Arctic waters, must be due to a bipolar distribution. The octopod collection is of interest in showing that Vampyroteuthis population of the Indian Ocean are confluent with those of the Atlantic and the Pacific Oceans round South Africa and south of Australia. It occurs between 500 m. and 1,000 m. and is limited to narrow salinity, density and temperature range. The pelagic Ostracods of

the Benguela current are of interest since their depth distribution shows nocturnal migration to surface. The papers on open boat whaling in the Azores and on the dispersal and migration of blue and fin whales add considerably to our knowledge of whaling as a commercial proposition.

This volume, like the rest of the *Discovery Reports* will form a valuable addition to any Zoological library.

C. P. GNANAMUTHU.

The Vitamins. (*Chemistry, Physiology, Pathology.*) Vol. I. Edited by W. H. Sebrell, Jr. and Robert S. Harris. (Academic Press, Inc., New York), 1954. Pp. xiii + 676. Price $ 16.50.

Recent advances in the field of vitamins have been so rapid and extensive that the existing books on this subject appear to be rather out of date. This volume, which is the first in a series of three volumes is intended to give an exhaustive account of the chemistry, physiology and pathology of vitamins and will, therefore, be welcomed as a very timely publication. The comprehensiveness in regard to the treatment of the subject may be understood from the fact that only four vitamins have been described in 618 printed pages, the treatment being accompanied by extensive references to world literature and by profuse illustrations with diagrams, tables and photographs.

The vitamins which have been taken up in alphabetical order and described here are: (*i*) vitamins A (and carotenes), (*ii*) ascorbic acid, (*iii*) vitamin B_{12}, and (*iv*) biotin. A notable feature of the volume is that each vitamin is not dealt with by any single individual but by eight or more specialists, who could speak authoritatively on certain sections by virtue of their research contributions. As the Editors state in their preface, 'this method will force the reader to change guides as he progresses through each chapter, but it will assure a higher level of competence'. Thus, a chapter dealing with a certain vitamin has, with minor variations, been treated under separate headings such as nomenclature and formula, chemistry, industrial preparation, biochemical systems, biogenesis, estimation, standardization, occurrence in food, effects of deficiency, pathology, pharmacology and requirements. Methods of synthesis of vitamins have been given in great detail; biochemical functions have been described in so far as they are understood at the present time, and due emphasis has been laid on vitamin deficiency conditions, particularly in experimental animals and birds. A few minor mistakes have been noticed in literature references 6 and 7 on page 212, and in reference 43 on page 618, which may be corrected in future editions. In the reviewer's opinion, this volume is an exceedingly fine compendium on every conceivable aspect of the four vitamins mentioned above, and though the price is rather on the high side, it should find a place on the bookshelf of all those who are interested in the subject of vitamins.

P. S. SARMA.

Books Received

Sex in Micro-Organisms. Edited by D. H. Wenrich, I. F. Lewis and J. R. Raper. (AAAS, Washington 5, D.C.), 1954. Pp. v + 362. Price $ 5.75.

Wave Motion and Vibration Theory, Vol. V. (Proceedings of the Fifth Symposium in Applied Mathematics of the American Mathematical Society). Edited by A. E. Heins. (McGraw-Hill), 1954. Pp. v + 169. Price $ 7.00.

Representative Chordates. (A Manual of Comparative Anatomy). By Charles K. Weichert. (McGraw-Hill), 1954. Pp. vii + 204. Price $ 3.50.

Genetic Homeostasis. By I. Michael Lerner. Oliver & Boyd—Macmillan, London), 1954. Pp. vii + 134. Price 12 *sh.* 6 *d.*

Animal Cytology and Evolution. By M. J. D. White. (Cambridge University Press), 1954. Pp. xiv + 454. Price 45 *sh.*

The Chemical Pathology of Animal Pigments. (Biochemical Society Symposia No. 12.) Edited by R. T. Williams. (Cambridge University Press), 1954. Pp. 84. Price 12 *sh.* 6 *d.*

Inorganic Chemistry. By H. D. Gehani and S. M. Parekh. (Educational Publishing Co., Bombay-4), 1954. Pp. 724. Price Rs. 10.

A Course of Practical Physics. By N. V. Kogekar and R. D. Gupte. (Educational Publishing Co., Bombay-4), 1954. Pp. 184. Price Rs. 4.

First Course in Physics. By R. D. Godbole, M. G. Mahajan, R. D. Gupte. (Model Publishing House, Bombay-4), 1954. Pp. 390. Price Rs. 6.

Weeds in Indian Agriculture. By C. Thakur. (Motilal Banarsidass, Bankipur, Patna), 1954. Pp. xv + 125. Price Rs. 7-8-0.

SCIENCE NOTES AND NEWS

***Cercospora* Leaf-Spot of *Tinospora cordifolia* Miers.**

K. A. Mahmud and Husne Ara Khatun, Department of Biology, University of Dacca, Dacca, report as follows:

Leaf-spot disease of *Tinospora cordifolia* Miers. due to *Cercospora tinosporæ* Syed., previously reported from the Philippine Islands (1916) and Ahmedabad (1935), was observed at Dacca in October 1953. The symptoms of the disease and the morphological characters of the pathogen were similar to those described by Sydow (1916) and Agrekar (1935). Inoculation tests gave positive results.

Nuffield Foundation Travelling Fellowships

Applications are invited from Indian Graduates for the Travelling Fellowships in Medical Sciences (Preventive and Social Medicine, and Genetics or Ophthalmology), Natural Sciences (Fundamental Studies in Mathematics or Physics or Dynamical Meteorology with Special Reference to Weather Forecasting), Engineering (Tele-Communication with Special Reference to Recent Developments or Metallurgical Engineering) and Social Sciences (Social Accounting with Particular Reference to Recent Developments in Techniques or Land Utilization and Management in Relation to Agricultural Planning) to be awarded by the Nuffield Foundation for 1955-56.

Copies of the announcement relating to the awards, and the application form can be had on request from the Secretary, Nuffield Foundation Indian Advisory Committee, Darbhanga House Annexe, 25, Akbar Road, New Delhi. The application (5 copies) is to reach the Secretary by January 15, 1955.

Zeitschrift für Kristallographie

After an interval of almost ten years, publication of the *Zeitschrift für Kristallographie* will be resumed. The publishers, Akademische Verlagsgesllschaft, m.b.H., Frankfurt am Main, announce that Volume 106, Number 2, will be released during October 1954.

Professors M. J. Buerger (Massachusetts Institute of Technology), F. Laves (Mineralogisch-petrographisches Institut der Eidg. Techn. Hochschule, Zurich), G. Menzer (Universitätsinstitut für Kristallographie und Mineralogie, München), and I. N. Stranski (Technische Universität, Berlin-Charlottenburg) have agreed to serve as editors of the journal.

Articles will be printed in German, English, French, and Italian. The *Zeitschrift für Kristallographie* will be published irregularly. One volume will consist of six issues, priced individually. (The price per volume will be approximately $ 16.65 or about DM 70.00.) Orders and inquiries about the *Zeitschrift* should be addressed to the publishers, Akademische Verlagsgesellschaft, m.b.H., Holbeinstrasse 25-27, Frankfurt am Main, Germany.

European Organization for Nuclear Research

The programme for the European Organization, ratified by a recent convention, includes the construction of a modern laboratory in Geneva for research in high energy particles. The laboratory will be equipped with large accelerators, a 600 Mev. synchro-cyclotron and a 25 proton synchrotron. The latter will be the most powerful machine in the world; it will reach energies ten times greater than the Brookhaven (U.S.A.) cosmotron and five times greater than the Berkeley (California) bevatron now under construction. The building of the laboratory and the apparatus is estimated at a hundred million Swiss Francs and will take seven years to complete.

The Organization will be responsible for international collaboration in research on the behaviour and composition of atomic nuclei and will investigate the relations between matter and energy by the study of individual neutrons, protons and other elementary particles such as those in cosmic rays. It will also undertake the training and exchange of scientists.

Prof. Felic Block, formerly of the Institute of Physics of Stanford University (U.S.A.), is to be the Director of the Organization. The creation of the Geneva Laboratory will provide European scientists with a research centre fully capable of dealing with contemporary scientific problems.

Wind Energy Research in Israel

Extensive research in the use of wind energy is now under way in Israel. Since 1953, a small windpower electric plant has supplied current for public buildings at Eilat on the Red Sea. Another plant is installed at Nebi Yosha, in Galilee. Eighteen observation posts have been set up to measure wind velocities

in different parts of the country by the Israel Scientific Council, with the technical assistance of UNESCO. It is expected that new installations will permit important savings in fuel and money.—UNESCO.

Institute for Nerve Research at Venezuela

A scientific centre for basic research in the field of neurology is to be established near Caracas, Venezuela. The Institute, one of the largest in the world, will include twelve central departments and is planned as a training centre for young scientists from the whole of Latin America, while leading specialists from all over the world will be invited as lecturers. Its programme will include neuro-physiology, biochemistry, embryology as well as cybernetics, etc. The Head of the new Institute is Professor Humberto Fernandez-Moran, the well-known neurologist and cytologist.

Molybdenum Disulphide as Lubricant

Molybdenum disulphide is a valuable special service lubricant in that it can be used at much higher temperatures and pressures, and also at rather lower temperatures than oils and greases. Chemically, it is strongly resistant except to oxygen, chlorine, fluorine and very strong acids. Whilst its adjacent molecular layers can slide easily over one another, its boundary layers adhere firmly to metals and to rubber. It builds up a layer of limited thickness only, so that overlubrication is unlikely to occur. Lubricated metal surfaces are kept apart under loads up to 350,000 lb./sq. in. It maintains good lubricant properties over a temperature range of $-100°$ to 750° F.; above this it is oxidised unless oxygen is excluded, in which case the upper temperature limit is about 2,000° F.

Diffusion Method of Treating Timber

The diffusion method of impregnating sapwood timber with boric acid and borax, developed by New Zealand scientists sometime ago, has proved commercially successful and cheap. A method that saves much of the handling costs at the treatment stage has now been worked out and successfully tested on *Pinus radiata* in the laboratory.

Freshly-sawn green 1" and 2" *Pinus radiata* only were used throughout the tests, but it is believed that the method may be suitable for sapwood of other timber species provided adjustments are made to the treatment. To be effective as a preservative, a minimum of 0·2 per cent. of boric acid must reach the core of the timber, and many factors influence successful impregnation, the main ones of which are thickness of the timber and its moisture content and density, the concentration of the treating solution, and the time allowed for diffusion before the timber is dried and handled in the normal way. The recommendations issued to commercial firms adopting this method, however, will enable the plant operator to make full use of the principles involved. (Information Bureau, D.S.I.R., New Zealand.)

New Type Lens for Clearer Vision

"Clear image" glasses were demonstrated recently before the Kentucky Optometric Association by their inventor, Dr. William Feinbloom, a Professor at Columbia University, New York.

Dr. Feinbloom describes his new lens as being "something like a telephoto lens with a wide vision". It would appear that for the first time the principles of aspherical surfaces are employed as an aid to the human eye. These surfaces are departures from the spherical surfaces found in ordinary spectacles or magnifying glasses. Thus, instead of being curved like a ball or sphere, the new lens is slightly flattened or parabolic (aspherical) towards the edges.

Role of Allergies in Heart Ailments

During the Second World Congress of Cardiology held recently, it was reported that the human heart can be allergic to a wide variety of external irritants. Allergic reactions of the heart can be responsible for serious and sometimes even fatal illness.

Manifestations of heart allergy may vary from disturbances of the rate and rhythm of the heart beat, to severe chest pains, coronary heart disease or damage to the heart muscle tissue. Among substances which affect the heart are tobacco, salicylates (aspirin), penicillin, pollen, some foods, and bacterial infections.

Symposium on Biochemistry of Vitamins

Under the joint auspices of the Society of Biological Chemists, India, Royal Institute of Chemistry (Deccan Section), Indian Medical Association (Bangalore Branch), and Indian Dairy Science Association, a symposium on "Recent Advances in the Biochemistry of Vitamins" will be held during the Easter for 1955. Abstracts of papers relating to (*a*) methods in vitamins research, (*b*) biological role of vitamins, (*c*) vitamins in nutrition and medicine, and (*d*) vitamins in food technology, may be sent to the Hon. Secretary, Society of Biological Chemists (India), Indian Institute of Science, Bangalore-3, before 31st January 1955.

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